# Electrical Review

WITH WHICH IS CONSOLIDATED WESTERN ELECTRICIAN AND ELECTROCRAFT.

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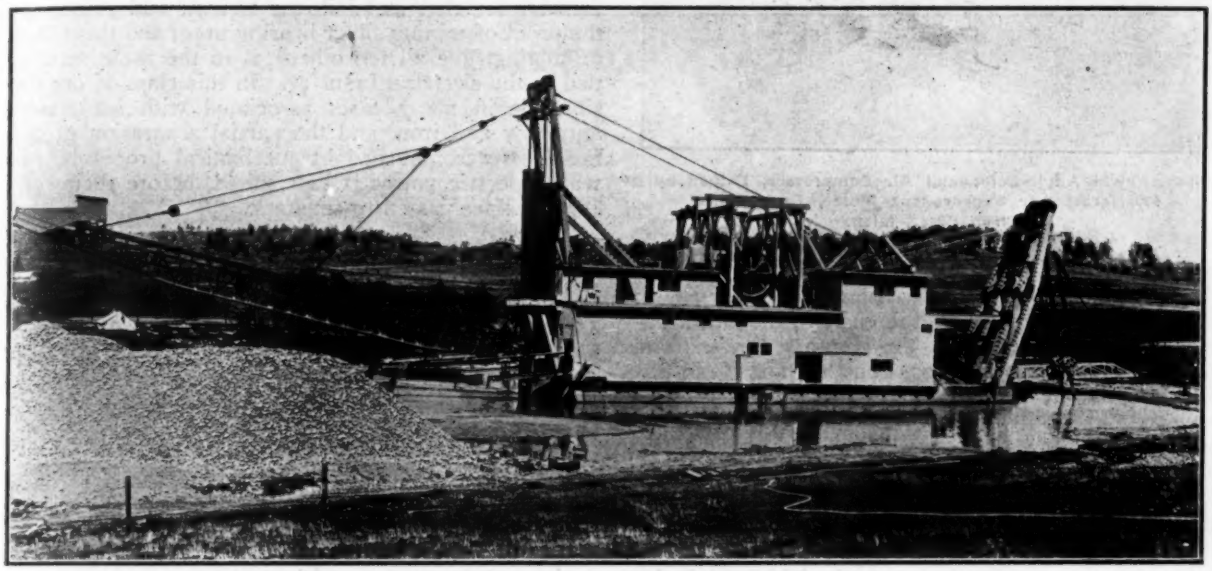


Electrically Operated Gold-Mining Dredge and Typical Dredging Scene in California.

# Electrical Manufacturers May Look to Metal Mining for Greater Output

***Present Heavy Demands for Metals, Which Doubtless Will Continue After War, Creates Increased Mining Activity—Steadily Widening Field for Electrical Equipment and Electric Power in the Metal Mines***

By W. A. SCOTT

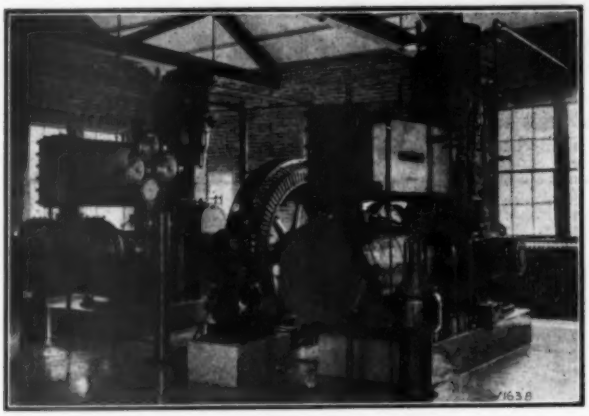
MANUFACTURERS of electrical machinery and equipment find now and will continue to find an excellent market for their products in the metal-mining industry. This has reference alike to the production of the industrial, precious and rare metals. War demands for iron and steel, copper, lead and zinc have stimulated the mining and reduction of those ores to great activity; and co-ordinately with the manufacture of the implements and munitions of war have come unprecedented demands for such metals as tungsten, chromium, platinum and other rare metals.

The wastes and sacrifices of the war will cause the demands for the metals to continue active long after its close. There will be in this country a period of construction to meet greater industrial requirements, and in Europe the period of reconstruction and rehabilitation will probably continue for years.

### Mining Men Favor Electric Power.

Now, the tendency in the mining industry, for reasons of economy and efficiency, is to utilize electric power to a greater extent in its various operations and processes. The adaptability of this energy to the operation of mine hoists, air compressors, pumps, ore crushers, concentrating machinery, to ore haulage and other work, was long ago demonstrated. The fact that many of the metal mines of the country are located near mountain streams on which there are hydroelectric plants has helped to make mining operations economically successful; and the extension of long transmission lines to mines in desert regions has brought to them similar results. The haulage of coal, oil and gasoline, for power production, to mines in isolated localities, has often been necessary, but it has usually been done at too high a cost In districts to which railroads have been built the use of coal or oil becomes more economical, but even under such conditions steam must yield to electric power as soon as the latter can be adequately served.

The adoption of electric energy on a large scale in the well developed mining districts has usually been due to central-station service. Among the notable



Sullivan Twin Angle-Compound Air Compressor, Driven by a 400-Horsepower Synchronous Motor, Brule Mine, Iron River, Mich.

examples of this there may be cited the Coeur d'Alene district of Idaho, where the Washington Water Power Company supplies most of the energy; the Butte district in Montana, served by the Montana Power Company, and such districts as Tonopah and Goldfield, Nev., served by transmission lines from California power stations. In the Coeur d'Alene and Butte districts the use of electric power has to a great extent supplanted steam power for which coal was used as fuel; and in the Nevada districts mentioned it has replaced steam produced by oil and gasoline as fuel.

In various other extensive mining districts, such as Ely, Nev., the electric power used, especially in the large mills, is produced in the steam-electric plants of the mining companies. The same may be said of several Colorado districts, where coal is mined near at hand and where it is comparatively cheap.

### Electrically Operated Dredges.

Gold dredging operations, carried on extensively in California, and on a considerable scale in Montana, Alaska, Yukon Territory, Idaho and Colorado, are conducted by electric power almost without exception, and the output of free gold by this method amounts to a big item in the country's annual gold production. The recovery of platinum and stream tin by electrically operated dredges is a matter of some importance. It is probable that this class of mining will continue on its present scale of operations in the states named, and may be greatly increased on the streams and beaches of Alaska.

### Electric Power in Milling Processes.

The present high price of silver, and the increasing demand for that metal in the Orient, add greatly to the profit of mining silver-bearing ores; and this phase of mining, like all the others, is in the same manner tied to the electrical industry. In this class of ore the silver is in many cases associated with lead, zinc, antimony and iron, and the partial separation of the metals is accomplished by mechanical processes, for which electric power is best suited, before their concentrates are passed to smelters.

### Changes from Steam to Electric Drive.

In numerous mining districts steam power is still largely employed, partly by reason of the nearness of coal supplies and because expensive steam plants have been built within the last few years and there has been a reluctance to make changes. But the present necessity for economizing in the use of coal naturally results in using those steam plants to generate electricity by the use of steam turbines, resulting not only in coal economy but cheaper and more flexible power through the motor drive at mines and mills.

### Electrical Equipment Will Be in Demand.

The greater development of the metal mining resources of the country, then, and the increasing output of the metal mines are certain to be accompanied by a much larger use of electric power and a correspondingly greater demand for electrical equipment. And, if the Federal Government will take the necessary action to remove the existing barriers to water-power development on our streams, in the West especially, a very large proportion of that greater supply of electric power will be derived from hydroelectric plants, thus conserving fuel for districts where power must continue to depend on it for producing steam.

Large Installation of Oil Flotation Units, Each Machine Driven by Individual Motor, at Miami, Arizona.

# Electricity in the Manufacture of Automobile Tires

## *Process of Tire-Making—Choice of Motors and Salient Features of Control, Applying Especially to Plant of the International India Rubber Company, South Bend, Ind.*

By B. B. JACKSON

*Sales Engineer, Fairbanks, Morse & Company.*

THE electric motor, through its well-known facilities for speed control and flexibility of application, has been one of the important factors in bringing the manufacture of automobile tires up to its present state of efficiency and perfection. Little does the critical purchaser of tires realize how the electric motor has responded to the click of circuit breakers, push buttons and switches, charging forward or backward, fast or slow, always giving just the right touch to the driven machine to give the greatest facility and perfection in production.

In order that the motors may do their bit, however, it is necessary that the application of the motors be made according to proved or well-analyzed methods. This requires a study or familiarity with the entire process of tire manufacture, including the purposes and characteristics of the individual machines and their arrangement on the floor for the most economical routing of the product through the plant.

In the plant of the International India Rubber Corporation, South Bend, Ind., both the possibilities of speed control and flexibility in arrangement of machines with electric drive have been taken advantage of to the fullest extent. Fig. 1 represents the arrangement of the machines on the floor, and the arrows show the progress of the work through the plant. The arrangement provides for a progressive movement of the work, with ample floor space at needed points to prevent any congestion. The effect of line shaft drive in its restraint upon the freedom of machine location and arrangement can be readily seen by trying to plan a line shaft drive for the machines, as shown in Fig. 1, that would not be extremely awkward and wasteful of power.

The following list is that of all power-driven machines used in the plant of the International India Rubber Corporation, arranged in the order that the work passes to them, with data covering their rating and nature of drive. All motors were furnished by Fairbanks, Morse & Company.

The name, rating and power required by the various machines in a rubber tire making plant has been included in this list. It now remains to explain the exact nature of the work done by each machine.

### Progress of Rubber Through the Plant.

Some of the raw rubber as it comes from the forests of South America (or in many cases the cultivated) is in 25- to 40-pound chunks resembling a large snapping turtle with one side round and full, and the opposite side quite flat, the latter being the surface produced by sawing the big knot of congealed sap free from the body of the tree.

Starting with the raw rubber just as it comes from the trees, the first operation undergone is "washing," which consists of passing it between two longitudinally grooved steel rolls upon which water plays as the rolls knead the rubber into a thin sheet called "crepe," a foot or more in width, the ends of which are joined together, making of it an endless belt. This the operator feeds continuously through the rolls for 3 to 5 minutes until the kneading action and spraying water have thoroughly cleared it of all foreign matter. The rolls of this machine are made about 16 inches in diameter by 3 feet long, and are driven by a 50-horsepower constant-speed slip-ring induction motor. The power is transmitted through intermeshing loose and tight cams on the driving shaft, the drawing back of the loose cam throwing the machine out of gear. Considerations of safety demand that some readily and quickly applied means of stopping the machine in easy reach of the operator be provided. This is accomplished by means of a trip hammer operated by a lever in front of the operator, the hammer having a wedge-

Electric Drive and Rubber Tires.

| No. | Application and make of machine. | Horse-power. | Motor type. | Speed r. p. m. | Remarks. |
|---|---|---|---|---|---|
| 1 | 16x30 ins. Birmingham washer | 50 | Squirrel-cage | 900 | |
| 1 | No. 12 J. P. Devine vacuum dryer | 3 | Squirrel-cage | 1200 | |
| 3 | 22-56-inch Birmingham mixing mills | 200 | Slip-ring | 600 | |
| 1 | 24x66 ins. Birmingham three-roll calender | 90 | Shunt-wound direct-current | 240/950 | |
| 1 | 4-roll Textile Finishing Machine Co.'s fabric dryer | 3 | Squirrel-cage | 1200 | |
| 1 | Allen Machine Co.'s No. 760 4-ins. tubing machine | 15 | Squirrel-cage | 900 | |
| 1 | 60-inch Cameron slitting and rewinding machine | 7½ | Squirrel-cage | 1200 | |
| 1 | Bennet O'Connell buffing stand | 2 | Squirrel-cage | 1200 | |
| 1 | Akron Rubber Mold & Machine Co.'s tube wrapping lathe. | 5 | Squirrel-cage | 1200 | These three machines are all driven from the same countershaft. |
| 1 | Akron Rubber Mold & Machine Co.'s rag roller | | | | |
| 1 | Bennet O'Connell buffing lathe | | | | |
| 1 | Allen skiving machine | 1 | Squirrel-cage | 1800 | |
| 1 | Akron Rubber Mold & Machine Co.'s tire buffing machine | 2 | Squirrel-cage | 1200 | |
| 1 | Pierce tire wrapping machine | 1 | Squirrel-cage | 1200 | |
| 3 | Rubber cement churns | 2 | Squirrel-cage | 1200 | Driven through line shaft |

shaped nose which in falling separates the cams on the driving shaft, thus throwing the machine instantly out of gear, and allowing the machine to come to rest while the motor continues to run until stopped in the usual way.

When a batch is finished on the washer, it goes to the drying oven, where it is dried under steam heat at 15 pounds' pressure in a vacuum oven. This oven occupies a space of about 5 by 5 by 7 feet high. The vacuum, which is about 26 inches, is produced by a small vacuum pump driven by a constant-speed squirrel-cage motor of 3 horsepower. The dried raw rubber is next weighed in the weighing room and laid out on the tables before the mixing mills. The function of these mills is to knead the rubber and to thoroughly mix into it portions of the various compound ingredients carefully weighed, the addition of which gives the batch greater strength and adhesiveness and makes it possible to roll it out into smooth, homogeneous layers. The mixing mills, which are illustrated in Fig. 4, consist of two polished steel rolls set in horizontal bank, and are steam heated or chilled with cold water as the friction of working rubber causes them to heat up so as to bring and maintain the rubber at a good working temperature of between 120 and 180 degrees Fahrenheit. The rubber is banked on top of the rolls, which start drawing it through the space of about 1/16 inch between their adjoining surfaces. As the rubber comes through it is allowed to adhere to one of the rolls for a number of revolutions of the rolls while the operator slashes across the roll with a sharp knife, peels off the layer and banks the rubber on top again. At first the rubber snaps and tears as it passes from between the rolls, looking ragged as it passes over, but as it gets heated and begins to absorb the chemicals the increased adhesiveness and plasticity cause it, after 10 to 30 minutes of working, to roll out into flat stable sheets.

### Making Rubber Into a Tire.

The product is now in the state in which it is sold commercially as raw rubber, and used to a large extent for patching automobile tires, in which operation it is turned into real rubber by vulcanization, which is a change in state induced by heating to the proper degree for a certain length of time, which may vary from only 10 minutes on a patch to 2 or 3 hours where a very thorough job is required, as in the production of inner tubes or automobile casings.

The electrical driving of these mills will be taken up in some detail a little later, meanwhile it is instructive to follow the raw rubber to the calender rolls, which is the largest and most important machine in the plant. This machine is illustrated in Fig. 3. The calender ordinarily carries three large vertically arranged polished steel rolls about 6 feet in length by 24 inches in diameter, and constructed so they can be heated with steam or chilled with cold water while turning. The direction of rotation is such that the middle and top rolls will draw the rubber between them from front to rear, while the middle and bottom rolls are at the same time drawing from rear to front. There are three important operations which the rubber calender rolls perform: they roll the rubber into sheets, they impregnate fabric with the rubber, or they join a layer of rubber on to impregnated fabric. Each

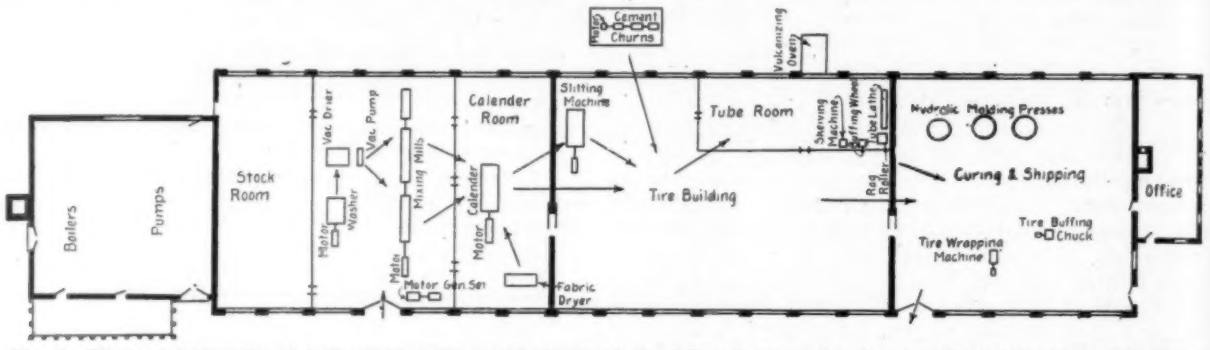



Fig. 1.—Plant of International India Rubber Corporation's South Bend Tire Factory, Showing Location of Machines and Routing of Rubber Through the Plant.

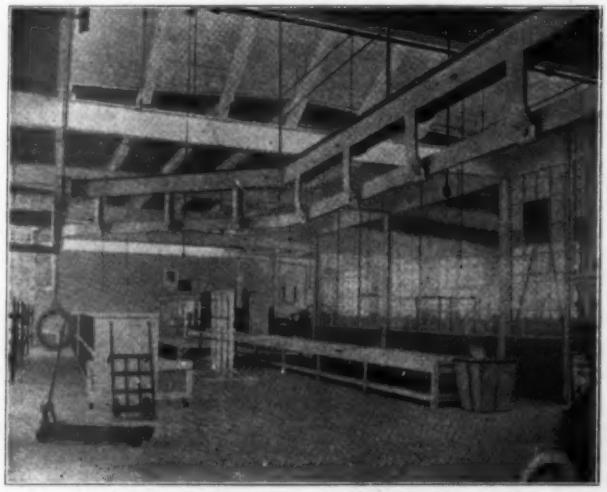


Fig. 2.—Corner of Cutting Room.

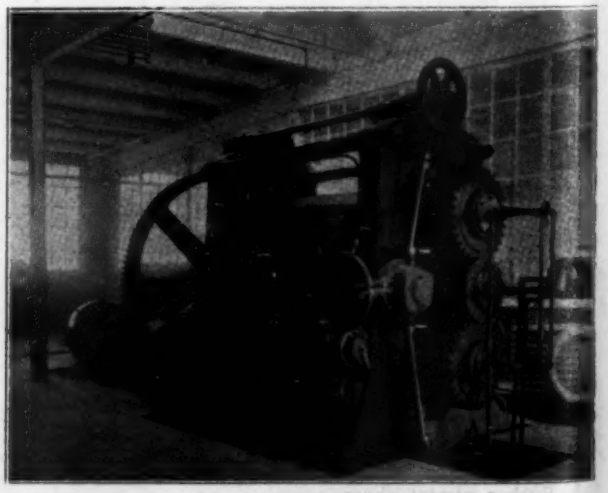


Fig. 3.—View of Calendar Rolls, Showing Motor Drive.

of these processes may require different heats and different speeds for the rolls according to the work, such as class of finished article.

The first process, called "sheeting" or "calendering," is done at low speeds. The impregnation of the fabric, called "frictioning," is done at high speeds, the term resulting from the friction produced by the practice of speeding one roll slightly faster than the other. The last process, called "skim coating," is done at medium speeds. In each of these processes the best speed will vary with the degree of heat and with the thickness of the sheet in skim coating and sheeting. Before the fabric can be impregnated with the rubber it must be very hot and thoroughly dried. The fabric, which for tires is a heavy white canvas, comes in stock rolls about 20 inches in diameter and 5 feet long. The dryer consists of four steam-heated copper cylinders over which the fabric passes as it is drawn from the stock roll.

The product from the calender rolls may be raw sheet rubber, impregnated fabric or rubber-coated fabric, and goes next to the slitting machine, or to the cutting table. The slitting machine is used mostly for slitting the rubber sheets or impregnated fabrics into long bands as required in the process of making the different parts of the tires. The work now evidently becomes divided into the making of inner tubes and the casings, the latter, of course, requiring the impregnated and rubber-coated fabric as well as the raw sheet rubber. With these three elements to work with, the casings are built up by hand over cores, after which they are placed in forming molds and subjected to heat and high pressure, which not only cures or vulcanizes the rubber, but makes it very dense and tough, as is required for the best wearing qualities on tires.

The strips of raw rubber which are to go into the making of inner tubes are sometimes cut by the slitting machine, and sometimes by knives at the calender, into strips measuring 10 inches wide by 12 feet long, depending on the size of the tire to be made. These are wrapped longitudinally around a hollow steel pole or mandrel of the diameter of the size of the tube to be made and are next centered in a long lathe and wrapped with tape. The mandrels are then run into a long steel oven mounted on a small truck, where they are allowed to cure for about two hours at about 300 degrees Fahrenheit, after which they are hauled out of the vulcanizing oven, centered in the long lathe where the tape is unwrapped, leaving a finished rubber tube stretched over the steel pole and all ready for joining the ends into a real automobile inner tube if it were only off the steel pole. Anyone who has skinned a rabbit will readily understand how the 10-foot length of rubber tube stretching over the steel pole can be taken off. Starting at one end, the tube is turned back over itself so that when it is all off the pole it has been turned inside out. When the tube has been pulled back about 6 inches over itself the friction between the rubber surfaces would prevent further pulling if a very efficient and novel scheme were

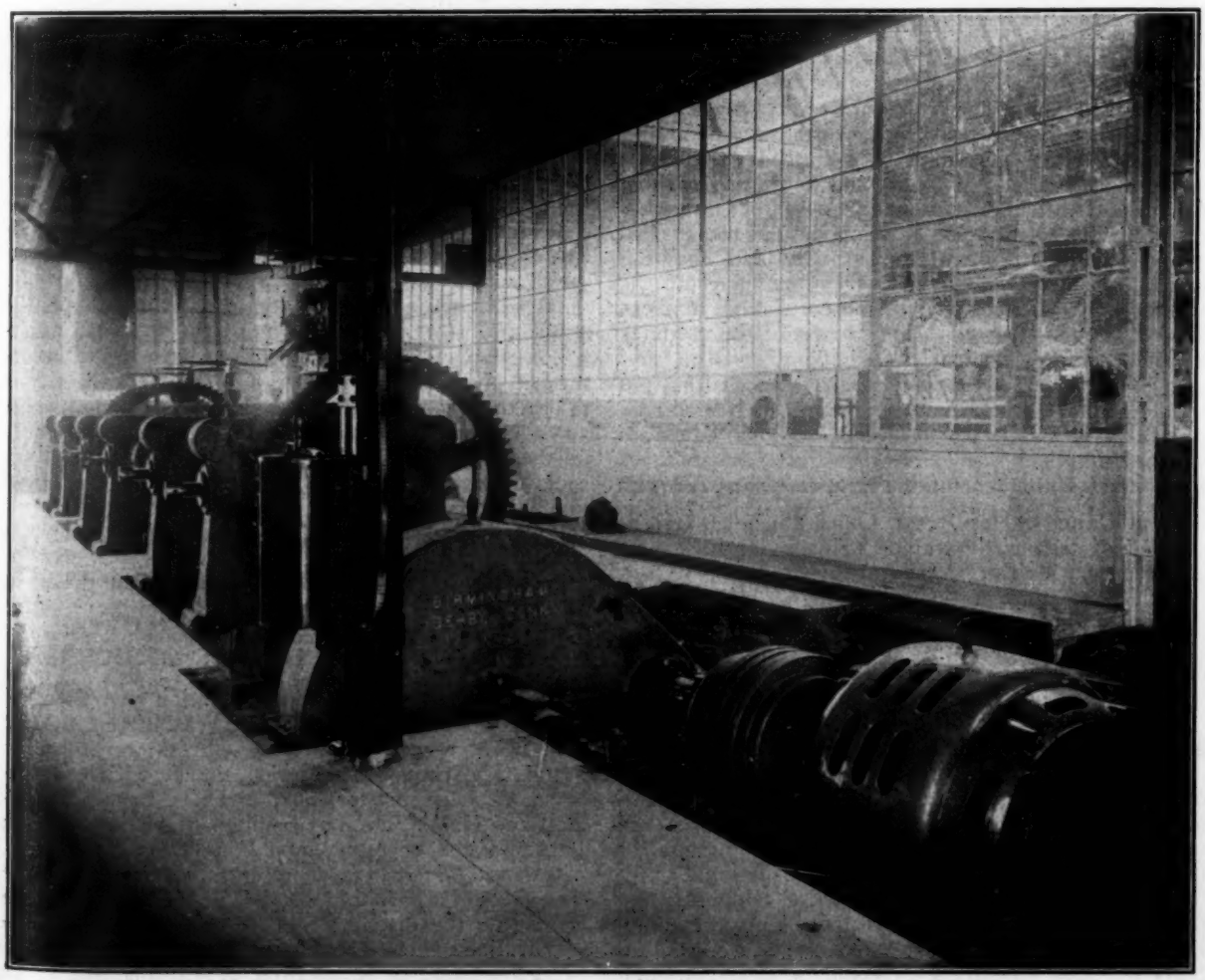


Fig. 4.—General View of Mixing Mills and Motor Drive.

not employed to eliminate this friction. The method used is to apply air pressure through a nozzle underneath the part turned back, so that this part is slightly blown up, thus separating the surfaces by an air cushion over which the surfaces will slide without appreciable friction.

Having gotten the tube free from the pole, the ends are next skeived for making a lap joint. This is done accurately and quickly on a marvelous little machine, so quickly, in fact, that it would take a dozen men doing it as it used to be done by hand to keep up with this one machine. The skeived ends are next cemented together by the use of raw rubber on the joint and the application of heat and pressure or by an acid cure process.

The three machines, lathe, skeiving machine and buffing lathe, concerned in the making of the inner tubes are grouped and driven by a 5-horsepower 1200-r. p. m. motor.

Fig. 5.—Group of Churns Driven from Shaft.

The slitting machine is driven by a 7½-horsepower slip-ring motor with speed variation between 600 and 1200 revolutions per minute. The speed variation is required for best results on account of the variation in thickness of the sheets to be cut.

With this general information on the process involved in the making of rubber tires and how the various machines each do their bit in carrying out the process, it remains to discuss more fully the application of electrical power to the driving of the calender rolls and of the rubber mills.

*(To be continued.)*

## PATENT OFFICE SEEKS EXAMINERS.

**Civil Service Examination to Be Held on August 21 and 22.**

The United States Patent Office advises that it is in need of technically trained persons for its examining corps. Men or women are desired who have a scientific education, particularly in higher mathematics, chemistry, physics, and French or German, and who are not subject to the draft for military service. Engineering of teaching experience in addition to the above is valued. The entrance salary is $1500.

Examinations for the position of assistant examiner are held frequently by the Civil Service Commission at many points in the United States. One is announced for August 21 and 22. Details of the examination, places of holding the same, etc., may be had upon application to the Civil Service Commission, or to the United States Patent Office, Washington, D. C.

Should the necessity therefor arise, temporary appointments of qualified persons may be made pending their taking the civil service examination. Applications for such appointment should be made to Commissioner of Patents J. S. Newton.

## UNIVERSITY OF ARIZONA ENCOURAGES STUDENTS IN ELECTRICAL ENGINEERING.

The College of Mines and Engineering, of the University of Arizona, has issued an interesting little booklet, dealing with the opportunities offered today and for the future in the field of electrical engineering. The facts set forth outline the qualifications and qualities of mind requisite to success in electrical engineering. They serve as a guide to the student in deciding for or against this or other branches of engineering. The facilities possessed by this university for giving the student training in electrical engineering are described and much interesting data are given concerning the demands for the electrical man in design, construction and operating.

Inquiry made of many of the most prominent electrical engineers in and around Chicago as to the three most promising fields of the electrical industry brought replies favoring electric railway work, telephony, transmission, electro-chemistry and power applications. The order in which these are given indicates their relative importance according to the responses received. The pay of electrical men is discussed and some figures are given showing range of salaries. Some useful suggestions are furnished on the relations of electrical to military engineering.

## TACOMA AUTHORIZES SEVEN-CENT STREET-CAR FARES.

**Arrangements for Coupon Tickets and Transfers From One System to Another.**

The City Council of Tacoma, Wash., has passed an ordinance providing for 7-cent cash fares anywhere in the city on any of the street-car lines, with provision for the sale of 15 tickets for $1, good anywhere in the city, and a 5-cent cash fare on the municipal line outside of the city limits; and universal transfers between the Tacoma Railway & Power Company and the municipal lines is also provided for. This action is the result of the recommendations of the special committee of 25 appointed from the various branches of industry and civic life in Tacoma. On transfers the city is to pay the Tacoma Railway & Power Company 3 cents for every transfer from the company lines taken up on the city line; and the company is to pay the city 3 cents for every transfer it receives from the municipal line. By this arrangement the city would get 3⅓ cents for every shipyard worker coming home from work and using the through ticket, and would get 2 cents for everyone going to work, the men buying the tickets at 15 for $1.

## DOHERTY CLUB ELECTS OFFICERS.

At the annual meeting and election of officers of the Stone and Webster Club of Washington, held at Seattle recently, the following officers were chosen: W. H. McGrath, Seattle, president; L. H. Bean, Tacoma, A. L. Kempster, Seattle, D. C. Barnes of Everett and H. W. Sewell of Bellingham, vice-presidents; E. A. Batwell, secretary, and F. P. Dexter, treasurer. The board of trustees represents the four cities, the district and the corporation. W. E. Herring of Seattle represents the district; S. L. Shuffleton, Seattle, the corporation; K. K. Carrick, of Everett; J. C. Hestor, of Bellingham; H. K. Monroe, of Tacoma, and F. M. Hamilton, of Seattle.

# Report on Estimating Labor Costs

## *Compiled by the Electrical Estimator's Association of Chicago and Presented at the Cleveland Convention of the NationalAssociation of Electrical Contractors and Dealers*

ESTIMATING LABOR will always be the personal judgment of the estimator based on his own experience and what he is able to learn from the experience of others. The estimator is largely responsible for the standards of the business in which he is engaged. It then becomes his duty to give forth the benefit of his experience to others engaged in the same work in order to enjoy the benefits of their experience, and in return to distribute this knowledge received so that all estimators will have a more definite knowledge of what it costs to install the various branches of the work and thereby produce more uniform bids and more consistent results in the estimated overhead and profit at the end of the year's business.

A group of Chicago estimators with the above ideas in mind assembled and organized in March, 1918, what is known as the Electrical Estimators' Association. This paper and the data accompanying same is the result of their efforts since that time.

The data set forth do not cover any special conditions as these would lead us into no end of detail with the result that nothing definite would be accomplished. They represent an average of all the members' judgments based on years of experience, and do not follow the stop-watch method, which often forgets the losses and delays which occur in the job. In brief, they are data collected from the bookkeeping of actual cost and aim to set forth those unit values for installing work that will produce a proper return on the year's business in accordance with the "Goodwin Plan." The "Goodwin Plan" is based on: know your cost and then add proper overhead and profit. One of the aims of the Electrical Estimators' Association is to know our costs. We do not hold up these units as final. They represent our best judgment to date and we cheerfully present them to you to confirm or modify as your own judgment directs.

Although labor data is the main subject to be discussed it might be well to touch upon the steps of an estimate leading up to and away from same. In general, we may consider the following topics as important to and bearing directly on the estimate.

### Steps in Preparing an Estimate.

First. Interpretation of specifications and plans.
Second. Measurement of quantities.
Third. Compilation of quantities.
Fourth. Pricing of material and labor.
Fifth. General tests applied to check the final estimates.

1. Unless the plans and specifications are clear, don't word your proposal in accordance with plans and specifications. Whenever any important part of the work is not definite and properly handled by the engineer and architect, the estimator should set forth in his proposal just what he included in his bid. This is the only sure way of protecting himself and employer and avoiding future unpleasant disputes with the architect or engineer.

2. We have found that the best method of measuring quantities is by means of a good watch-type resetting map-measuring machine. In taking off quantities it is a good plan to use common chalk in marking off the items taken from the plans, also in marking the circuit runs, as this may readily be removed by means of a dust cloth and will work on either blue prints or hectograph prints. Marking conduit runs is imperative for no estimator should attempt to carry same in his head, as it is impossible to do so with any degree of certainty on any size plans.

3. From the rough sheets used in taking down the various items as they are taken from the plans the quantities should be totaled up and grouped under their proper heading and then listed in the individual sheets for pricing labor and material. From these individual sheets they are readily transferred to a summary sheet where the totals may be considered as a whole or individual and may be readily checked by the various practical tests applied to same.

No matter what method you use in reaching the summary sheet (and every estimator thinks his own method is the best) the work in general may be divided into two general heads, "Roughing in" and "Finishing." These may be further divided to suit the individual taste or manner of figuring a job, but for this purpose these are the two important steps to a job.

By referring to the sample estimate herewith presented you will note the two divisions are further divided. The "Roughing in" is divided into: first—conduit, and, second—conduit fittings, and the "Finishing" is divided into: first—wire and, second—wire fittings.

If the estimators would adopt a standard general method similar to above, the checking of estimates would become more uniform and the discussion of estimates more intelligent. Should one firm desire to discuss or check its estimate with another, this may readily be done, providing the estimators make up their estimates along some definite general headings as set forth above. This would in no way interfere with the individual system as the estimator could separate the general heads into as many divisions as would suit his individual system or fancy.

4. Pricing of material is a part of estimating readily acquired by the estimator, but the pricing of labor is an important uncertainty in the routine of an estimator's life that causes him more concern than any other part of his estimate. It is this subject we are all vitally interested in and is really the main object of our paper.

The labor data which you have before you are the result of the best efforts of the Electrical Estimators' Association of Chicago, acting as a body in the compilation of their experience in electrical construction. They represent the average results, based on bookkeeping costs, of an association whose membership is comprised of 24 estimators representing the foremost electrical contracting firms in the city of Chicago. We do not set forth these units as final, but feel that if they serve as a good outline for detail discussion and act as an encouragement for the estimators in other cities

to engage in like efforts, we have accomplished at least a good start toward a better knowledge of labor cost and more hearty co-operation of electrical estimators in general.

It is not for us to go into detail discussion of the individual units, as that is what is expected of you. We are here more in the spirit of presenting them and to answer to the best of our ability any questions pertaining to same that may arise in your consideration of these data.

Briefly, we have tabulated the units in the sequence in which they are used in the estimate. You will note the units listed in dollars and cents are based on $7.00 a day labor, the present Chicago scale. In addition to this tabulation, we set forth the units per day so that they may be reduced to any scale of wages.

Following the unit labor data is a concrete example of the application of same in the form of an estimate, carried all the way through to a conclusion.

You will note at the end of the estimate the practical checks which brings us to the last topic of our paper.

5. As we are about to send in our estimate, we would always feel safer if we could only give it a general checking and find that in the main it conforms pretty well to the tests given. It doesn't mean that any rule is going to be exact but everything that points to the fact that our estimate is following in a general way results obtained on similar work helps to make us feel we have not made any radical or serious mistakes. Therefore, all the good methods we can get together for checking estimates are well worth while.

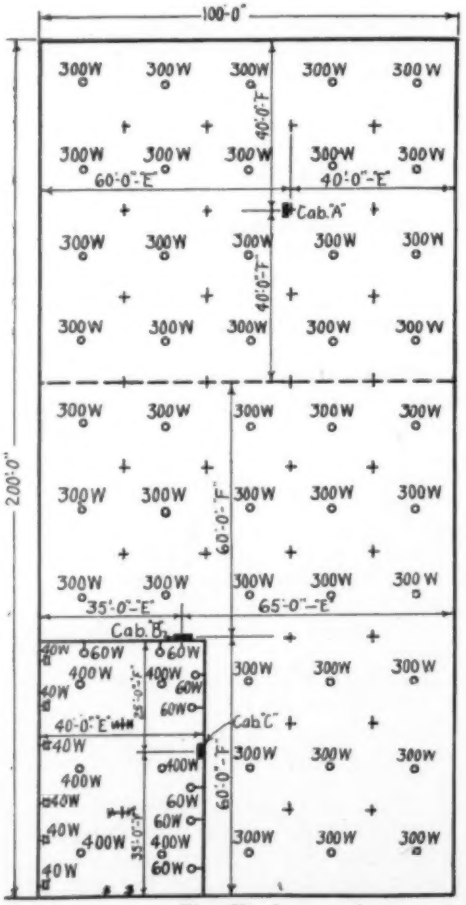
The example sets forth that the material cost multiplied by 2.3 equals the selling price. At the present-day material prices it is the material cost multiplied by 2.0 to 2.3 equals the selling price, depending on how much overhead and profit you are adding to the job, 2.3 representing about 25 per cent overhead and 20 per cent profit.

Another check is to take the number of outlets on a job and divide same by 2; the result should be approximately the number of days of labor required.

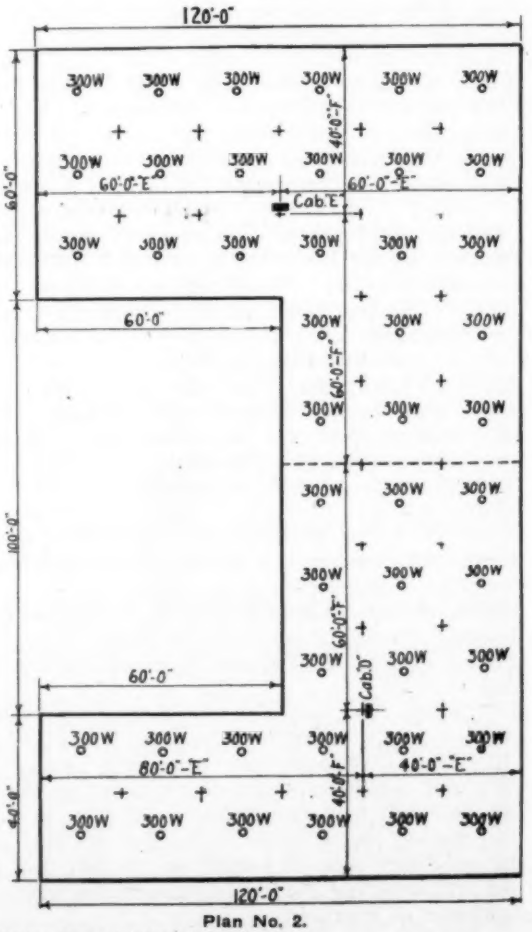
## A Good Method of Proving Quantities for Lighting Tap Circuits.

Conduit and wire are a large portion of any estimate. A good check on these items will serve to correct more mistakes than anything we know of. It is with some degree of satisfaction that the Electrical Estimators' Association of Chicago is able to herewith present to you a method of checking the quantities on conduit and wire that has been used by some of their individual members over a period of five years and with very good results. It eliminates all guesswork, such as "We think is will average 15 feet to the outlet or maybe 20 or even 25 feet." This method absolutely tells you.

On over one hundred jobs quantities arrived at by this method were in excess of the actual quantities secured by measuring from plans from 1 to 3 per cent. It applies to any shape or class of building except churches, theaters and like special cases where there are a great many vertical runs and very high ceilings. It will even serve as a good check on the lat-




Plan No. 1.




Plan No. 2.

Plans Illustrating Method of Proving Quantities for Lighting Tap Circuits.

ter but will not come within the above prescribed limits of percentages.

The checking naturally divides itself into two equations, one for the conduit from outlets to outlets and the other for the circuit runs to the lighting cabinets.

TABLE 1—ROUGHING IN CONDUIT AND ELBOWS.

| Conduit Size. | Cost per Foot at $7.00 per Day. A.* | B.† | Feet per Day per Man. A.* | B.† |
|---|---|---|---|---|
| ½" | $0.05 | $0.09 | 140 | 78 |
| ¾" | .065 | .10 | 108 | 70 |
| 1" | .09 | .12 | 78 | 58 |
| 1¼" | .125 | .14 | 56 | 50 |
| 1½" | .16 | .17 | 44 | 40 |
| 2" | .215 | .215 | 33 | 33 |
| 2½" | .275 | .275 | 26 | 26 |
| 3" | .34 | .34 | 21 | 21 |
| 3½" | .42 | .42 | 17 | 17 |
| 4" | .50 | .50 | 14 | 14 |
| Elbows. | | | No. per Day. | No. per Day. |
| 1" | .15 | .20 | 46 | 35 |
| 1¼" | .20 | .25 | 35 | 28 |
| 1½" | .35 | .40 | 20 | 17 |
| 2" | .50 | .50 | 14 | 14 |
| 2½" | .75 | .75 | 9 | 9 |
| 3" | 1.00 | 1.00 | 7 | 7 |
| 3½" | 1.50 | 1.50 | 5 | 5 |
| 4" | 2.00 | 2.00 | 3 | 3 |

*A—Open pipe, mill construction and simple concealed work.
†B—Open pipe, fireproof construction and difficult concealed work.
Add extra labor for cutting, openings, channeling, and other conditions requiring same.
BX-14—Per foot 10c; 70 ft. per day.

EXAMPLES.

$A$ = area in square feet of space supplied by outlets;
$B$ = number of outlets, including ceiling, brackets, receptacles, switches, etc.;
$C$ = average length in feet between outlets;
$D$ = total length in feet between all outlets;
$E$ = distance in feet between cabinet and one extreme of space supplied by cabinet;
$F$ = distance in feet between cabinet and the other extreme of space supplied by cabinet;
0.6=constant ascertained by experiments;

TABLE 2—ROUGHING IN CONDUIT FITTINGS.

| NON-FIREPROOF. | Labor—$7.00 Rate. A. | B. | Time— A. | B. |
|---|---|---|---|---|
| Ceiling outlets | $0.15 | $0.30 | 0-10′ | 0-21′ |
| BK., SW., and B. P. outlets. | .20 | .40 | 0-14′ | 0-27′ |
| T-fix. hanger | .50 | .75 | 0-34′ | 0-51′ |
| ⅜ fix. stud | .05 | .08 | 0-03′ | 0-05′ |
| Floor box | 1.50 | 2.00 | 1-42′ | 2-18′ |
| FIREPROOF. | | | | |
| Ceiling outlets | .40 | .50 | 0-28′ | 0-34′ |
| BK., SW., and B. P. outlets. | .50 | .70 | 0-34′ | 0-48′ |
| Suspended outlets | 1.00 | 1.50 | 1-09′ | 1-42′ |
| Floating outlets | .75 | 1.00 | 0-51′ | 1-09′ |
| T-fix. hanger | .75 | 1.00 | 0-51′ | 1-09′ |
| Floor box | 2.00 | 3.00 | 2-18′ | 3-27′ |
| CHANNELING PER FT. | | | | |
| Soft brick | .20 | .30 | 0-14′ | 0-21′ |
| Green concrete | .25 | .35 | 0-17′ | 0-24′ |
| Set concrete | .30 | .40 | 0-21′ | 0-27′ |
| ¼" X 1¾" EXP. BOLTS. | | | | |
| Soft brick | .10 | .15 | 0-07′ | 0-10′ |
| Green concrete | .15 | .20 | 0-10′ | 0-14′ |
| Set concrete | .20 | .30 | 0-14′ | 0-21′ |
| LIGHTING C. O. B. | | | | |
| Per circuit | .50 | .75 | 0-34′ | 0-51′ |

For service switch and power C. O. B. labor see lug rule. Double labor for bricked in outlets.

$G$ = average length in feet of circuit run to cabinet;
$H$ = total number of circuits;
$I$ = total length in feet of circuit runs to cabinet.

*Equation No. 1.*

$$\sqrt{A \div B} = C$$
$$C \times B = D.$$

*Equation No. II.*

$$0.6\sqrt{E^2 + F^2} = G.$$
$$G \times H = I.$$

To serve as a better guide we shall consider the two problems represented in plan No. 1 and plan No. 2.

PLAN NO. 1.

44....300-watt ceiling outlets.
6....400-watt ceiling outlets.
7.... 60-watt bracket outlets.
6.... 40-watt base outlets.
6....S. P. switches.

69 = number of outlets.
Cabinet A....10 circuits.
Cabinet B....12 circuits.
Cabinet C.... 8 circuits.

Applying Equation No. 1.

$A = 200 \times 100 = 20{,}000$ sq. ft.
$B = 69$.
$\sqrt{A \div B} = \sqrt{20{,}000 \div 69} = 17$.
$C \times B = 17 \times 69 = 1173$ feet.

To this figure you must add the vertical distances down to the switches, base plugs, brackets and ceiling outlets.

TABLE 3—FINISHING LABOR.

| B. & S. Gauge of Wire. | Cost per Foot of Each Wire. Labor—$7 per Day. 1 Wire. | 2 Wire. | 3 Wire. | Feet per Day per Man. 1 Wire. | 2 Wire. | 3 Wire. |
|---|---|---|---|---|---|---|
| No. 14 dup | $..... | $0.01 | $..... | ..... | 700 | ..... |
| No. 14 | ..... | .0055 | .005 | ..... | 1,275 | 1,400 |
| No. 12 | ..... | .007 | .006 | ..... | 1,000 | 1,166 |
| No. 10 | ..... | .009 | .008 | ..... | 777 | 875 |
| No. 8 | ..... | .013 | .01 | ..... | 538 | 700 |
| No. 6 | ..... | .015 | .012 | ..... | 466 | 583 |
| No. 4 | ..... | .018 | .015 | ..... | 390 | 466 |
| No. 3 | ..... | .022 | .018 | ..... | 320 | 390 |
| No. 2 | ..... | .027 | .02 | ..... | 260 | 350 |
| No. 1 | ..... | .03 | .023 | ..... | 233 | 305 |
| No. 0 | .05 | .037 | .028 | 140 | 190 | 250 |
| No. 2/0 | .06 | .042 | .033 | 116 | 166 | 212 |
| No. 3/0 | .07 | .05 | .037 | 100 | 140 | 190 |
| No. 4/0 | .085 | .06 | .043 | 82 | 116 | 163 |
| 300 M. | .10 | .07 | .05 | 70 | 100 | 140 |
| 400 M. | .12 | .085 | .06 | 58 | 82 | 116 |
| 500 M. | .145 | .10 | .073 | 48 | 70 | 96 |
| 600 M. | .165 | .115 | .08 | 42 | 61 | 87 |
| 700 M. | .18 | .125 | .087 | 39 | 56 | 80 |
| 800 M. | .19 | .135 | .093 | 37 | 52 | 75 |
| 900 M. | .195 | .138 | .097 | 36 | 51 | 72 |
| 1,000 M. | .20 | .14 | .10 | 35 | 50 | 70 |

Intercommunicating telephone cable labor ¼c per foot for each conductor. Average length of pipe run for feeders, 100 feet.

Assume 12′-0″ ceiling and ceiling outlets in concrete slab.

Then: 50 ceiling outlets × 1′ = 50′
(bracket 7′-0″ high)
7 bracket outlets × 5′ = 35′
(base 2′-0″ high)
6 base outlets × 2′ = 12′
(switch 4′-0″ high)
6 S. P. switches × 8′ = 48′

145
Plus 1173 from above.

Total = 1318 feet.

Applying Equation No. II.

Cabinet A.

$0.6\sqrt{E^2 + F^2} = 0.6\sqrt{60^2 + 40^2} = 43 = G.$
$0.6\sqrt{E^2 + F^2} = 0.6\sqrt{40^2 + 40^2} = 34 = G.$
$(43 + 34) \div 2 = 38\frac{1}{2}'$ = average $G$ for Cabinet A.

Cabinet B.

$0.6\sqrt{35^2 + 60^2} = 42.$
$0.6\sqrt{65^2 + 60^2} = 53.$
$(42 + 53 \div 2 = 47\frac{1}{2}'$ = average $G$ for Cabinet B.

Cabinet C.

$0.6\sqrt{40^2 + 25^2} = 28.$
$0.6\sqrt{40^2 + 35^2} = 42.$
$(28 + 42) \div 2 = 35'$ = average $G$ for Cabinet C.

TABLE 4—FINISHING UP LABOR ON WIRE FITTINGS.

| | Labor, $7.00 Rate. | Time. | No. per Day. |
|---|---|---|---|
| S. P. switches | $0.25 | 0—17′ | 28 |
| D. P. switches | .35 | 0—24′ | 20 |
| 3 and 4-way switches | 1.40 | 1—36′ | 5 |
| Door switches | 1.75 | 2—00′ | 4 |
| Base plugs | .30 | 0—21′ | 24 |
| Cover sockets | .25 | 0—17′ | 28 |
| Drop cords | .40 | 0—27′ | 18 |
| 1-light factory fixture | .70 | 0—48′ | 10 |
| Lighting pan. per circuit | .35 | 0—24′ | 20 |
| No. 10 wire lighting ground | 1.00 | 1—09′ | 7 |
| No. 4 wire light.ng ground | 1.40 | 1—36′ | 5 |
| No. 10 wire motor ground | .60 | 0—42′ | 12 |
| No. 4 wire motor ground | 1.00 | 1—09′ | 7 |
| 30A—2 wire meter loops | 1.00 | 1—09′ | 7 |
| 30A—3 wire meter loops | 1.20 | 1—22′ | 6 |
| 60A—3 wire meter loops | 2.50 | 1—42′ | 3 |
| 100A—3 wire meter loops | 5.00 | 3—24′ | 1 |
| 30- 60 A-2 W. meter | 1.00 | 1—09′ | 7 |
| 30- 60 A-3 W. meter | 1.20 | 1—22′ | 6 |
| 60-100 A-2 W. meter | 1.75 | 2—00′ | 4 |
| 60-100 A-3 W. meter | 2.35 | 2—41′ | 3 |
| Bells, setting and testing | .50 | 0—34′ | 14 |
| Push buttons, setting and testing | .50 | 0—34′ | 14 |

Intercommunicating telephones, connecting, setting and testing, allow 20c per wire connection, or 35 connections per day.

TABLE 5—COST OF SOLDERING LUGS.

| Amperes. Lug. | Size of Wire. | Rate, $7.00. | Time, Each | No. per Day. |
|---|---|---|---|---|
| 30 | No. 8 | $0.18 | 0—12′ | 38 |
| 50 | No. 6 | .25 | 0—17′ | 28 |
| 60 | No. 4 | .30 | 0—21′ | 23 |
| 75 | No. 3 | .35 | 0—24′ | 20 |
| 100 | No. 1 | .40 | 0—27′ | 17 |
| 150 | No. 00 | .50 | 0—34′ | 14 |
| 175 | No. 000 | .55 | 0—38′ | 13 |
| 200 | No. 0000 | .60 | 0—42′ | 12 |
| 250 | 300 M | .65 | 0—45′ | 11 |
| 300 | 350 M | .75 | 0—51′ | 9 |
| 350 | 400 M | .90 | 1—03′ | 8 |
| 400 | 500 M | 1.00 | 1—09′ | 7 |
| 500 | 700 M | 1.20 | 1—22′ | 6 |
| 600 | 800 M | 1.30 | 1—30′ | 5 |
| 700 | 900 M | 1.40 | 1—36′ | 5 |
| 800 | 1,000 M | 1 50 | 1—42′ | 5 |
| 1,000 | 1,500 M | 2.00 | 2—18′ | 3 |

For wire terminals, not requiring lugs (Nos. 14, 12, 10 and 8 wire), labor 10c per wire connection.

Lug Rule.—For total labor setting distributing cabinets with panels, and knife switches and cabinets, double the cost of labor for soldering lugs.

TABLE 6—LABOR ERECTING MEDIUM-SPEED MOTORS.

| H.P. | Erecting Motors at $7.00 Rate. Floor. | Ceiling. | Erecting Motors. Time in Hr. and Min. Floor. | Ceiling. |
|---|---|---|---|---|
| 1 to 3 | $ 3.50 | $ 7.00 | 4—00′ | 8—00′ |
| 5 | 5.00 | 10.00 | 5—43′ | 11—25′ |
| 7.5 | 7.00 | 11.00 | 8—00′ | 12—34′ |
| 10 | 8.00 | 12.00 | 9—06′ | 13—42′ |
| 15 | 10.00 | 15.00 | 11—25′ | 17—08′ |
| 20 | 12 00 | 20.00 | 13—42′ | 22—50′ |
| 25 | 14.00 | 25.00 | 16—00′ | 28—33′ |
| 30 | 18.00 | 30.00 | 20—31′ | 34—16′ |
| 40 | 21.00 | 45.00 | 24—00′ | 51—23′ |
| 50 | 24.00 | 60 00 | 27—25′ | 68—32′ |
| 75 | 35.00 | ..... | 40—00′ | ....′ |
| 100 | 40.00 | ..... | 45—40′ | ....′ |
| 125 | 50.00 | ..... | 57—06′ | ....′ |
| 150 | 60.00 | ..... | 68—32′ | ....′ |

Values based on ground-floor handling.
Motors to be handled without special equipment.
Add extra labor for motor supports.
Extra labor to be added for hoisting above ground floor.

TABLE 7—LABOR CONNECTING MEDIUM-SPEED MOTORS.

| H.P. | Setting Starter and Connecting Motor at $7.00 Rate. D.C. | A.C. | Setting Starters and Connecting Motors. Time in Hr. and Min. D.C. | A.C. |
|---|---|---|---|---|
| 1 to 3 | $ 3.50 | $ 2.00 | 4—00′ | 2—17′ |
| 5 | 4 00 | 2.50 | 4—34′ | 2—51′ |
| 7.5 | 5.00 | 7.00 | 5—43′ | 8—00′ |
| 10 | 6.00 | 8.00 | 6—51′ | 9—06′ |
| 15 | 7.50 | 10.00 | 8—34′ | 11—2″′ |
| 20 | 9 00 | 12.00 | 10—17′ | 13—42′ |
| 25 | 10.00 | 14.00 | 11—25′ | 16—00′ |
| 30 | 11.00 | 15.00 | 12—34′ | 17—08′ |
| 40 | 13.00 | 16.50 | 14—51′ | 18—51′ |
| 50 | 14 00 | 18.00 | 16—00′ | 20—34′ |
| 75 | 17.00 | 23.00 | 19—25′ | 26—16′ |
| 100 | 20.00 | 26.00 | 22—50′ | 29—42′ |
| 125 | 24.00 | 30.00 | 27—25′ | 34—16′ |
| 150 | 25.00 | 40.00 | 28—33′ | 45—40′ |

Add 50 per cent extra labor for slip-ring motors, simple starter.
Add extra labor for starter supports.
Use lug rule for setting and connecting motor control switch.
(Under this rule figure the same amount of labor for setting cabinet and panel or switch as allowed for soldering lug connections attached to same.)

TABLE 8—SAMPLE ESTIMATE.

Estimate No. 117. Sheet No. 1.

| Quantity. | Description. | Unit Price. | Total Cost. | Labor Unit. | Total Labor. |
|---|---|---|---|---|---|
| | **Roughing in Black Conduit C.** | | | | |
| 10,000 | ½″ black cond. | $ 8.00 | $800.00 | $0.05 | $500.00 |
| 1,000 | ¾″ black cond. | 10.60 | 106.00 | .065 | 65.00 |
| 600 | 1″ black cond. | 15.70 | 94.20 | .09 | 54.00 |
| 800 | 1¼″ black cond. | 21.20 | 169.20 | .125 | 100.00 |
| 300 | 1½″ black cond. | 25.35 | 76.05 | .16 | 48.00 |
| 12 | 1″ black ells. | .50 | 6.00 | .15 | 1.80 |
| 8 | 1¼″ black elbows | .60 | 4.80 | .20 | 1.60 |
| 6 | 1½″ black elbows | .80 | 4.80 | .35 | 2.10 |
| | Total | | $1,261.05 | | $772.50 |
| | **Conduit Fittings.** | | | | |
| 120 | 8 B cell. outlets | .10 | 12 00 | .40 | 48.00 |
| 140 | 1,900 bkt. outlets and covers | .15 | 21.00 | .50 | 70.00 |
| 60 | Single sw. outlets and cov | .17 | 10.20 | .50 | 30.00 |
| 10 | 2 gang sw. outlets and covers | .20 | 2.00 | .50 | 5.00 |
| 4 | 3 gang sw. outlets and covers | .30 | 1.20 | .50 | 2.00 |
| 2 | Door sw. outlets and covers | .40 | .80 | .50 | 1.00 |
| 30 | Recpt. outlets and covers | .17 | 5.10 | .50 | 15.00 |
| 3 | Floor boxes | 3.00 | 9.00 | 2.00 | 6.00 |
| 600 | ½″ lock nuts and bush. | 2.25 | 13.50 | ..... | ..... |
| 200 | ¾″ lock nuts and bush. | 3.00 | 6.00 | ..... | ..... |
| 100 | 1″ lock nuts and bush. | 4.25 | 4.25 | ..... | ..... |
| 30 | 1¼″ lock nuts and bush. | 7.50 | 2.25 | ..... | ..... |
| 10 | 1½″ lock nuts and bush. | 10 00 | 1 00 | ..... | ..... |
| 200 | ⅜″ fixture studs | .05 | 10.00 | .08 | 16.00 |
| 60 | T hangers | .20 | 12.00 | .75 | 45.00 |
| 1 | Ser. cab 60″x24″x10″ | 28.00 | 28.00 | L.R. | 10.50 |
| | 400 amp. 3P switch | ..... | ..... | ..... | ..... |
| | 2 100 amp. 3P branches | ..... | ..... | ..... | ..... |
| | 2 75 amp. 3P branches | ..... | ..... | ..... | ..... |
| 1 | 20 cir. lt. cabinet | 20 00 | 20.00 | .50 | 10.00 |
| 2 | 16 cir. lt. cabinets | 16 00 | 32.00 | .50 | 16.00 |
| 2 | 10 cir. lt. cabinets | 10.00 | 20.00 | .50 | 10.00 |
| | Cartage 2% cond. cost | ..... | 25.00 | ..... | ..... |
| | Total | | $ 235.30 | | $284.50 |
| | Grand total | | 1,496.35 | | 1,057.00 |

Estimate No. 117. Sheet No. 2.

| | | | | | |
|---|---|---|---|---|---|
| | **Finishing Up Code Wire, 30c Base.** | | | | |
| 5,000 | No 14 S. B. simcore | 10.50 | 52.50 | .005 | 25.00 |
| 10,000 | No. 14 twin simcore | 22.00 | 220.00 | .01 | 100.00 |
| 1,400 | No. 12 D. B. simcore | 15.00 | 21.00 | .007 | 9.80 |
| 400 | No. 6 D. B. simcore | 54.00 | 21.60 | .012 | 4.80 |
| 200 | No. 4 D. B. simcore | 76.00 | 15.20 | .015 | 3.00 |
| 150 | No. 2 D. B. simcore | 110 00 | 16.50 | .02 | 3.00 |
| 100 | No. 1/0 D. B. simcore | 170.00 | 17.00 | .028 | 2.80 |
| | Total | | $363.80 | | $148.40 |
| | **Fittings.** | | | | |
| 6 | 1/0 lugs, 150 A. | .12 | .72 | .50 | 3.00 |
| 12 | 2 lugs, 100 A | .08 | .96 | .40 | 4.80 |
| 10 | 4 lugs, 75 A | .05 | .50 | .35 | 3.50 |
| 14 | 6 lugs, 50 A | .05 | .70 | .25 | 3.50 |
| 76 | S. P. push switches | .60 | 45.60 | .25 | 19.00 |
| 12 | 3 W. push switches | .90 | 10.80 | 1 40 | 16.80 |
| 4 | 4 W. push switches | 1.90 | 7.60 | 1.40 | 7.00 |
| 2 | Door switches | 2 00 | 4.00 | 1.75 | 3.50 |
| 30 | Receptacles | 1 00 | 30.00 | .30 | 9.00 |
| 1 | Ser. panel | ..... | 65.00 | L.R. | 10.50 |
| | 400 amp. 3P switch | ..... | ..... | ..... | ..... |
| | 2 100 amp. 3P branches | ..... | ..... | ..... | ..... |
| | 2 75 amp. 3P branches | ..... | ..... | ..... | ..... |
| 1 | 20 cir. lt. panel | 2 00 | 40 00 | .35 | 7.00 |
| 2 | 16 cir. lt. panels | 2.00 | 64 00 | .35 | 11.20 |
| 2 | 10 cir. lt. panels | 2.00 | 40 00 | .35 | 7.00 |
| | Insp. fee, 600 lights | ..... | 31.50 | ..... | ..... |
| | Solder tape, 5% wire C | ..... | 18.00 | ..... | ..... |
| | Freight cart., 2% wire C | ..... | 7.25 | ..... | ..... |
| | Total | | $366.63 | | $105.80 |
| | Grand total | | 730.43 | | 254.20 |

Estimate No. 117. Sheet No. 3.

| | | | | | |
|---|---|---|---|---|---|
| | 1-3 H.P. pump-run | ..... | ..... | ..... | ..... |
| | 35′ stop at switch | ..... | ..... | ..... | ..... |
| | 1-5 H.P. fan-run | ..... | ..... | ..... | ..... |
| | 50′ stop at switch | ..... | ..... | ..... | ..... |
| 80 | No. 14 S. B. simcore | 10.80 | .86 | .005 | .40 |
| 110 | No. 10 D. B. simcore | 20.00 | 2.20 | .009 | .99 |
| 35 | ½″ black cond. | 8.00 | 2.80 | .08 | 2.80 |
| 50 | ¾″ black cond. | 10 60 | 5.30 | .10 | 5.00 |
| 2 | 60 amp. 2P sw. and cab. | 5.00 | 10.00 | L.R. | .80 |
| | Total | | $21.16 | | $9.99 |
| | **10 Int. Teleph.** | | | | |
| 10 | Telephones | 15.00 | 150.00 | 4.80 | 48.00 |
| 400 | 24 cond. lead cable | 20.00 | 80 00 | .06 | 24.00 |
| 380 | ¾″ black cond. | 10.60 | 40.28 | .07 | 29.60 |
| 1 | Set batt. and cab. | 5.00 | 5.00 | ..... | 2.00 |
| | Total | | $275.28 | | $103.60 |
| | Grand total | | 296.44 | | 113.59 |

## SUMMARY SHEET OF ESTIMATE.

| | | |
|---|---|---|
| No. lights .....500 | Bid to, R. T. Jones. | Estimate No. 117. |
| No. switches ... 86 | Address, 1420 Wells St. | Date, 7-17-1918. |
| No. circuits .... 52 | Archt. or Engr., L. Hawley. | Job. No. ——. |
| No. base plugs.. 30 | Address, 910 Houston Ave. | Checked by R. A. M. |
| No. tel. ..... 10 | Name of job, Smith Residence. | Bid on 7-17-18. |
| No. motors ..... 2 | Location, 1015 Sherman St. | Opened 7-17-18. |
| No. fixtures .... — | See Mr. Smith. | Let 7-18-18. |
| H.P. motors.... 8 | Tel. No. Central 42. | For $6,109.00. |
| K.W. gen. ..... — | | |
| Switchboard ... — | | |
| Days' labor.....210 | Est. by A. C. M. | Priced by J. R. S. |

| No. | Material. | Cost. | Labor. |
|---|---|---|---|
| 1 | Conduit | $1,261.05 | $ 772.50 |
| 1 | Conduit fittings | 253.30 | 248.50 |
| 2 | Wire | 363.80 | 148.40 |
| 2 | Wire fittings | 366.63 | 105.80 |
| 3 | Power wiring | 21.16 | 10.00 |
| 3 | Low tension | 275.28 | 103.60 |
| | Total | $2,541.22 | $1,388.80 |
| | Labor | 1,388.80 | ..... |
| | Delays | 50.00 | ..... |
| | Handling material | 20.00 | ..... |
| | Board | ..... | ..... |
| | Car fare | 10 00 | ..... |
| | 1½% liability insurance | 22 00 | ..... |
| | Drafting | 12.00 | ..... |
| | Incidentals | 25.00 | ..... |
| | Cost, material and labor | $4,069.02 | ..... |
| | 25% overhead | 1,017.25 | ..... |
| | Net cost | $5,086.27 | ..... |
| | 20% profit | 1,017.25 | ..... |
| | Selling price | $6,103.52 | ..... |
| | Price quoted | 6,100.00 | ..... |

### TABLE 9—CONDUIT SIZES FOR WIRES.

| Brown & Sharpe Gauge-Wire. | Amperes. | Size of Conduits. 1 Wire. | 2 Wires. | 3 Wires. | 4 Wires. |
|---|---|---|---|---|---|
| *14 | 15 | ½ | ¾ | 1 | 1 |
| *12 | 20 | ½ | ¾ | 1 | 1¼ |
| *10 | 25 | ¾ | 1 | 1¼ | 1¼ |
| 14 | 15 | ½ | ½ | ½ | ¾ |
| 12 | 20 | ½ | ¾ | ¾ | ¾ |
| 10 | 25 | ½ | ¾ | ¾ | 1 |
| 8 | 35 | ½ | 1 | 1 | 1 |
| 6 | 50 | ½ | 1 | 1 | 1¼ |
| 5 | 55 | ¾ | 1¼ | 1¼ | 1¼ |
| 4 | 70 | ¾ | 1¼ | 1¼ | 1½ |
| 3 | 80 | ¾ | 1¼ | 1¼ | 1½ |
| 2 | 90 | ¾ | 1¼ | 1½ | 1½ |
| 1 | 100 | ¾ | 1½ | 1½ | 2 |
| 0 | 125 | 1 | 1½ | 2 | 2 |
| 00 | 150 | 1 | 2 | 2 | 2½ |
| 000 | 175 | 1 | 2 | 2 | 2½ |
| 0000 | 225 | 1¼ | 2 | 2½ | 2½ |
| 225,000 CM | 230 | 1¼ | 2 | 2½ | 2½ |
| 250,000 | 240 | 1¼ | 2½ | 2½ | 3 |
| 300,000 | 275 | 1¼ | 2½ | 2½ | 3 |
| 400,000 | 325 | 1¼ | 3 | 3 | 3½ |
| 500,000 | 400 | 1½ | 3 | 3 | 3½ |
| 600,000 | 450 | 1½ | 3 | 3½ | ... |
| 700,000 | 500 | 2 | 3½ | 3½ | ... |
| 800,000 | 550 | 2 | 3½ | 4 | ... |
| 900,000 | 600 | 2 | 3½ | 4 | ... |
| 1,000,000 | 650 | 2 | 4 | 4 | ... |
| 1,250,000 | 750 | 2½ | 4½ | 4½ | ... |
| 1,500,000 | 850 | 2½ | 4½ | 5 | ... |
| 1,750,000 | 950 | 3 | 5 | 5 | ... |
| 2,000,000 | 1,050 | 3 | 5 | 6 | ... |

*Twin.

### TABLE 10—CAPACITY OF WIRES FOR LIGHTING FEEDERS.

| Brown & Sharpe Gauge Wire. | Ampere capacity. | Feeder wattage. | 3 Wire System, 220-110-220. Lamp Wattage. 25 | 40 | 50 | 60 | 75 | 100 |
|---|---|---|---|---|---|---|---|---|
| 14 | 15 | 3,300 | 132 | 82 | 66 | 55 | 44 | 33 |
| 12 | 20 | 4,400 | 176 | 110 | 88 | 73 | 58 | 44 |
| 10 | 25 | 5,500 | 220 | 137 | 110 | 91 | 73 | 55 |
| 8 | 35 | 7,700 | 308 | 192 | 154 | 128 | 102 | 77 |
| 6 | 50 | 11,000 | 440 | 275 | 220 | 183 | 146 | 110 |
| 4 | 70 | 15,400 | 616 | 385 | 308 | 256 | 205 | 154 |
| 3 | 80 | 17,600 | 704 | 440 | 352 | 293 | 234 | 176 |
| 2 | 90 | 19,800 | 792 | 495 | 396 | 330 | 264 | 198 |
| 1 | 100 | 22,000 | 880 | 550 | 440 | 366 | 293 | 220 |
| 0 | 125 | 27,500 | 1,100 | 687 | 550 | 458 | 366 | 275 |
| 00 | 150 | 35,000 | 1,320 | 825 | 660 | 550 | 440 | 330 |
| 000 | 175 | 38,500 | 1,540 | 962 | 770 | 641 | 516 | 385 |
| 0000 | 225 | 49,500 | 1,980 | 1,237 | 990 | 825 | 660 | 495 |
| 250,000 | 240 | 52,800 | 2,112 | 1,320 | 1,056 | 880 | 704 | 528 |
| 300,000 | 275 | 60,500 | 2,420 | 1,512 | 1,210 | 1,008 | 806 | 605 |
| 350,000 | 300 | 66,000 | 2,640 | 1,650 | 1,320 | 1,100 | 880 | 660 |
| 400,000 | 325 | 71,500 | 2,860 | 1,787 | 1,430 | 1,191 | 953 | 715 |
| 450,000 | 372 | 81,840 | 3,272 | 2,040 | 1,636 | 1,364 | 1,090 | 818 |
| 500,000 | 400 | 88,000 | 3,520 | 2,200 | 1,760 | 1,466 | 1,173 | 880 |
| 550,000 | 425 | 93,500 | 3,740 | 2,337 | 1,870 | 1,558 | 1,246 | 935 |
| 600,000 | 450 | 99,000 | 3,960 | 2,475 | 1,980 | 1,650 | 1,320 | 990 |
| 650,000 | 475 | 104,500 | 4,180 | 2,612 | 2,090 | 1,741 | 1,393 | 1,045 |
| 700,000 | 500 | 110,000 | 4,400 | 2,750 | 2,200 | 1,833 | 1,466 | 1,100 |
| 750,000 | 525 | 115,500 | 4,620 | 2,887 | 2,310 | 1,925 | 1,540 | 1,155 |
| 800,000 | 550 | 121,000 | 4,840 | 3,025 | 2,420 | 2,016 | 1,613 | 1,210 |
| 900,000 | 600 | 132,000 | 5,280 | 3,300 | 2,640 | 2,200 | 1,760 | 1,320 |
| 1,000,000 | 650 | 143,000 | 5,720 | 3,575 | 2,960 | 2,383 | 1,906 | 1,430 |
| 1,250,000 | 750 | 165,000 | 6,600 | 4,125 | 3,300 | 2,750 | 2,200 | 1,650 |

### TABLE 11—SHOWING TOTAL H.P. ALLOWED ON WIRES AS MAINS.

| Wire Feeder Sizes. Brown & Sharpe Gauge. | Carrying Capacity. Amperes. | 2-Wire Direct Current. 220 Volts. H.P. | 3-Phase, A.C., 3-Wire System. Voltages. 220 | 440 |
|---|---|---|---|---|
| | | | Horsepower. | |
| 14 | 15 | 4 | 5 | 10 |
| 12 | 20 | 5 | 7½ | 15 |
| 10 | 25 | 6 | 9 | 19 |
| 8 | 35 | 7½ | 13 | 27 |
| 6 | 50 | 13 | 19 | 39 |
| 4 | 70 | 18 | 27 | 55 |
| 3 | 80 | 21 | 31 | 62 |
| 2 | 90 | 24 | 35 | 70 |
| 1 | 100 | 26 | 40 | 80 |
| 0 | 125 | 33 | 50 | 100 |
| 00 | 150 | 40 | 55 | 117 |
| 000 | 175 | 46 | 70 | 136 |
| 0060 | 225 | 60 | 90 | 175 |
| 250,000 | 240 | 64 | 93 | 187 |
| 300,000 | 275 | 73 | 107 | 214 |
| 350,000 | 300 | 80 | 117 | 234 |
| 400,000 | 325 | 86 | 126 | 253 |
| 450,000 | 372 | 99 | 145 | 290 |
| 500,000 | 400 | 106 | 156 | 312 |
| 550,000 | 425 | 113 | 166 | 332 |
| 600,000 | 450 | 120 | 175 | 351 |
| 650,000 | 475 | 126 | 185 | 371 |
| 700,000 | 500 | 133 | 195 | 390 |
| 750,000 | 525 | 140 | 205 | 410 |
| 800,000 | 550 | 146 | 214 | 429 |
| 900,000 | 600 | 160 | 234 | 468 |
| 1,000,000 | 650 | 173 | 253 | 507 |
| 1,250,000 | 750 | 200 | 292 | 585 |

Note.—Use only for mains supplying more than one motor.

### TABLE 12—WIRE AND CONDUIT FOR D. C. MOTOR WIRING.

| 220 Volts H.P. | Full Load Current. | One Motor. | Conduit, 2 Wires. | Mains More Than 1 Motor. | Conduit, 2 Wires. |
|---|---|---|---|---|---|
| 1 | 4 | 14 | ½ | 14 | ½ |
| 2 | 8 | 14 | ½ | 14 | ½ |
| 3 | 12 | 14 | ½ | 14 | ½ |
| 4 | 15 | 12 | ¾ | 14 | ½ |
| 5 | 19 | 10 | ¾ | 12 | ¾ |
| 7.5 | 28 | 8 | 1 | 8 | 1 |
| 10 | 38 | 6 | 1 | 6 | 1 |
| 12.5 | 47 | 4 | 1¼ | 6 | 1 |
| 15 | 56 | 4 | 1¼ | 5 | 1¼ |
| 17.5 | 65 | 3 | 1¼ | 4 | 1¼ |
| 20 | 75 | 1 | 1½ | 3 | 1¼ |
| 25 | 94 | 0 | 1½ | 1 | 1½ |
| 30 | 113 | 00 | 2 | 0 | 1½ |
| 35 | 131 | 000 | 2 | 00 | 2 |
| 40 | 150 | 0000 | 2 | 00 | 2 |
| 45 | 169 | 0000 | 2 | 000 | 2 |
| 50 | 188 | *250 | 2½ | 0000 | 2 |
| 55 | 206 | 300 | 2½ | 0000 | 2 |
| 60 | 225 | 300 | 2½ | 0000 | 2 |
| 65 | 244 | 350 | 2-1¼ | *250 | 2½ |
| 70 | 263 | 400 | 2-1¼ | 300 | 2½ |
| 75 | 281 | 500 | 2-1¼ | 300 | 2½ |
| 80 | 300 | 500 | 2-1½ | 350 | 2-1¼ |
| 85 | 319 | 500 | 2-1½ | 400 | 2-1¼ |
| 90 | 338 | 600 | 2-1½ | 500 | 2-1½ |
| 95 | 356 | 600 | 2-1½ | 500 | 2-1½ |
| 100 | 375 | 700 | 2-2 | 500 | 2-1½ |
| 125 | 463 | 900 | 2-2 | 700 | 2-2 |
| 150 | 563 | 1,100 | 2-2 | 800 | 2-2 |
| 200 | 750 | 1,700 | 2-3 | 1,300 | 2-2½ |
| 250 | 938 | 2- 900 | 4-2 | 1,700 | 2-3 |
| 300 | 1,125 | 2-1,100 | 4-2 | 2- 800 | 4-2 |

*C.M.

### TABLE 13—WIRE AND CONDUIT FOR A. C. MOTOR WIRING.

| 220 Volts H.P. | Full Load Current. | One Motor. | Conduit, 3 Wires. | Mains More Than 1 Motor. | Conduit, 3 Wires. |
|---|---|---|---|---|---|
| 1 | 3 | 14 | ½ | 14 | ½ |
| 2 | 5 | 14 | ½ | 14 | ½ |
| 3 | 8 | 14 | ½ | 14 | ½ |
| 4 | 10 | 14 | ½ | 14 | ½ |
| 5 | 13 | 12 | ¾ | 14 | ½ |
| 7.5 | 19 | 8 | 1 | 12 | ¾ |
| 10 | 26 | 6 | 1 | 8 | 1 |
| 12.5 | 32 | 6 | 1 | 8 | 1 |
| 15 | 38 | 4 | 1¼ | 6 | 1 |
| 17.5 | 45 | 4 | 1¼ | 6 | 1 |
| 20 | 51 | 3 | 1¼ | 6 | 1 |
| 25 | 64 | 1 | 1½ | 4 | 1¼ |
| 30 | 77 | 0 | 2 | 3 | 1¼ |
| 35 | 90 | 00 | 2 | 2 | 1½ |
| 40 | 102 | 00 | 2 | 1 | 1½ |
| 45 | 115 | 000 | 2 | 0 | 2 |
| 50 | 128 | 0000 | 2½ | 0 | 2 |
| 55 | 141 | 0000 | 2½ | 00 | 2 |
| 60 | 154 | *250 | 2½ | 000 | 2 |
| 65 | 166 | 300 | 2½ | 000 | 2 |
| 70 | 179 | 300 | 2½ | 000 | 2 |
| 75 | 192 | 350 | 2½ | 0000 | 2½ |
| 80 | 205 | 400 | 3 | 0000 | 2½ |
| 85 | 218 | 400 | 3 | 0000 | 2½ |
| 90 | 230 | 500 | 3 | 0000 | 2½ |
| 95 | 243 | 500 | 3 | *300 | 2½ |
| 100 | 256 | 500 | 3 | 300 | 2½ |
| 125 | 320 | 700 | 3½ | 400 | 3 |
| 150 | 384 | 900 | 4 | 500 | 3 |
| 200 | 512 | 2-500 | 2-3 | 700 | 3½ |
| 250 | 640 | 2-700 | 2-3½ | 1,000 | 4 |
| 300 | 768 | 3-500 | 3-3 | 2-500 | 2-3 |

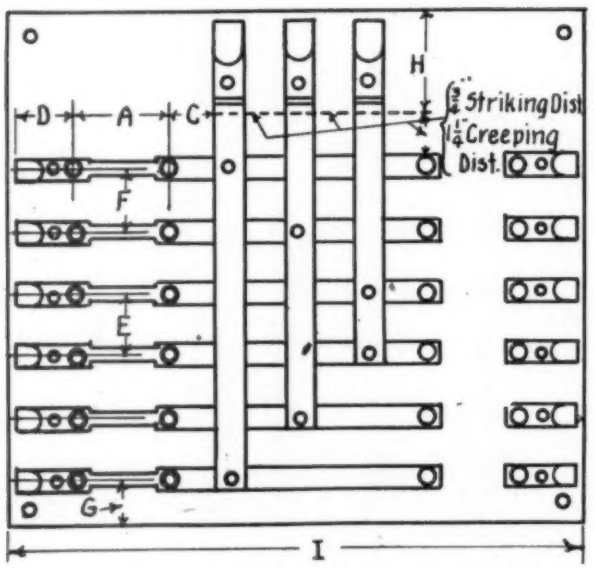
*C.M.

TABLE 14—WIRE AND CONDUIT FOR A. C. MOTOR WIRING.

| 440 Volts H.P. | Full Load Current. | One Motor. | Mains More Conduit, 3 Wires. | Than 1 Motor. | Conduit, 3 Wires. |
|---|---|---|---|---|---|
| 1 | 2 | 14 | ½ | 14 | ½ |
| 2 | 3 | 14 | ½ | 14 | ½ |
| 3 | 4 | 14 | ½ | 14 | ½ |
| 4 | 5 | 14 | ½ | 14 | ½ |
| 5 | 6 | 14 | ½ | 14 | ½ |
| 7.5 | 10 | 14 | ½ | 14 | ½ |
| 10 | 13 | 12 | ¾ | 14 | ½ |
| 12.5 | 16 | 10 | ¾ | 12 | ¾ |
| 15 | 19 | 8 | 1 | 12 | ¾ |
| 17.5 | 22 | 8 | 1 | 10 | ¾ |
| 20 | 26 | 6 | 1 | 8 | 1 |
| 25 | 32 | 6 | 1 | 8 | 1 |
| 30 | 38 | 4 | 1¼ | 6 | 1 |
| 35 | 45 | 4 | 1¼ | 6 | 1 |
| 40 | 51 | 3 | 1¼ | 5 | 1¼ |
| 45 | 58 | 2 | 1½ | 4 | 1¼ |
| 50 | 64 | 1 | 1½ | 4 | 1¼ |
| 55 | 70 | 0 | 2 | 4 | 1¼ |
| 60 | 77 | 0 | 2 | 3 | 1¼ |
| 65 | 83 | 0 | 2 | 2 | 1½ |
| 70 | 90 | 00 | 2 | 2 | 1½ |
| 75 | 96 | 00 | 2 | 1 | 1½ |
| 80 | 102 | 00 | 2 | 1 | 1½ |
| 85 | 109 | 000 | 2 | 0 | 2 |
| 90 | 115 | 000 | 2 | 0 | 2 |
| 95 | 122 | 0000 | 2½ | 0 | 2 |
| 100 | 128 | 0000 | 2½ | 0 | 2 |
| 125 | 160 | *250 | 2½ | 000 | 2 |
| 150 | 192 | 350 | 2½ | 0000 | 2½ |
| 200 | 256 | 500 | 3 | *300 | 2½ |
| 250 | 320 | 700 | 3½ | 400 | 3 |
| 300 | 384 | 900 | 4 | 500 | 3 |

*C.M.

TABLE 15—POWER PANELBOARDS (LINK FUSES), 125 AND 250 VOLTS.




| Amperes. | A | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|
| 30 | 2¼" | 1⅛" | 1¼" | 2 " | 2½" | 2½" | 1⅜" | |
| 60 | 2¼" | 1½" | 1⅝" | 2 " | 2½" | 2½" | 1⅝" | ... |
| 100 | 3 " | 1½" | 2½" | 2 " | 2½" | 2¾" | 2½" | ... |
| 200 | 3½" | 2 " | 3½" | 2¼" | 3½" | 2⅞" | 3¼" | ... |
| 300 | 3½" | 2 " | 4¼" | 2¼" | 3½" | 2⅞" | ... | ... |
| 400 | 4 " | 2 " | 5 " | 2¼" | 4 " | 2⅞" | 5 " | ... |
| 600 | 4 " | 2 " | 6¼" | 2½" | 4 " | 3 " | 6¼" | ... |
| 800 | 4½" | 2½" | 7⅞" | 3 " | 4½" | 3 " | ... | ... |
| 1,000 | 4½" | 2½" | 8⅞" | 3 " | 4½" | 3 " | ... | ... |
| 1,200 | 5 " | 2½" | 8⅞" | 3 " | 5 " | 3½" | ... | ... |

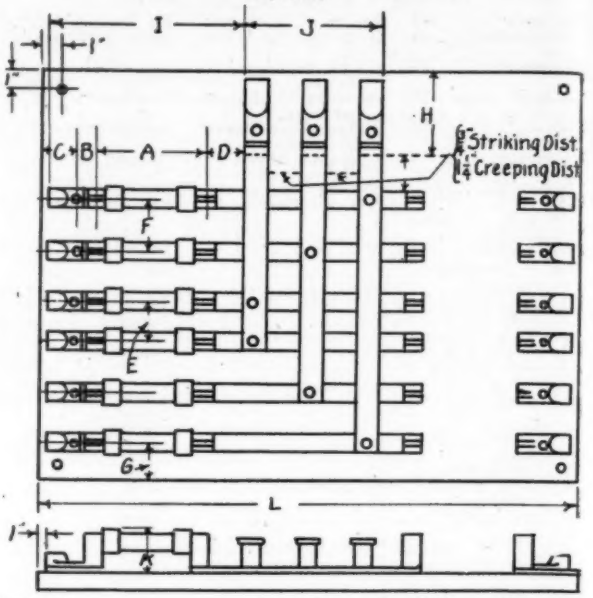
COPPER SIZES FOR MAINS AND BRANCH BARS.
1,000 Amp. Rating.

| Amperes | 30 | 60 | 100 | 150 | 200 | 300 |
|---|---|---|---|---|---|---|
| Copper sizes | ⅛x⅛" | ⅝x⅛" | ¾x3/16" | 1x3/16" | 1x¼" | 1¼x¼" |
| Amperes | | 400 | 500 | 600 | 700 | 800 |
| Copper sizes | | 1¼x⅜" | 1½x⅜" | 1½x½" | 2x⅜" | 2x7/16" |

$(38\frac{1}{2} + 47\frac{1}{2} + 35) \div 3 = 40' =$ average $G$.
Assume all circuit wire to be No. 14 Duplex.
Vertical drop to cabinet = 7'-0".
$H$ = 30 circuits.
$I = 30 \times 40 =$ 1200
Vertical drop $30 \times 7 =$ 210

1410 feet.

TABLE 16—POWER PANELBOARDS (ENCL. FUSES), 125 AND 250 VOLTS.



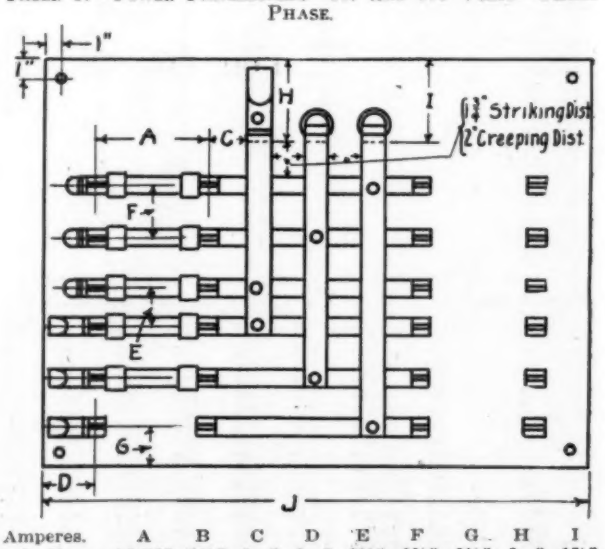

| Amperes. | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 0- 30 | 1½" | ¾" | ¾" | 1⅛" | 1¼" | 1¾" |
| 31- 60 | 2⅜" | ¾" | 1 " | 1¼" | 1½" | 2 " |
| 61-100 | 4⅞" | 1 " | 1½" | 1⅞" | 1⅝" | 2¼" |
| 101-200 | 5¾" | 1¼" | 2⅛" | 1½" | 2¼" | 2¾" |
| 201-400 | 6¾" | 2 " | 3⅜" | 1¾" | 3 " | 3½" |
| 401-600 | 8⅛" | 2½" | 4¼" | 2 " | 3½" | 4 " |

| Amperes. | G | H | I | J | K | L |
|---|---|---|---|---|---|---|
| 0- 30 | 2½" | 1⅜" | 3 " | 4 " | 1 1/16" | 12 " |
| 31- 60 | 2½" | 1¾" | 4⅛" | 4⅜" | 1¼" | 14⅜" |
| 61-100 | 2¾" | 2½" | 7⅜" | 4¾" | 1¾" | 21-½" |
| 101-200 | 2⅞" | 3⅜" | 9⅛" | 5½" | 2⅜" | 25¾" |
| 201-400 | 2⅞" | 5¼" | 12⅜" | 7 " | 3¼" | 33¾" |
| 401-600 | 3 " | 6¼" | 14⅞" | 8½" | 3¾" | 40¼" |

COPPER SIZES FOR MAINS AND BRANCH BARS.
1,000 Amp. Rating.

| Amperes | 30 | 60 | 100 | 150 | 200 | 300 |
|---|---|---|---|---|---|---|
| Copper sizes | ⅛x⅛" | ⅝x⅛" | ¾x3/16" | 1x3/16" | 1x¼" | 1¼x¼" |
| Amperes | | 400 | 500 | 600 | 700 | 800 |
| Copper sizes | | 1½x¼" | 1½x⅜" | 2x⅜" | 2x⅝" | 2x7/16" |

TABLE 17—POWER PANELBOARDS—440 AND 600 VOLTS—THREE PHASE.




| Amperes. | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 0- 30 | 4 7/16" | 1¼" | 2 " | 2 " | 2½" | 2¾" | 2½" | 2 " | 1⅞" |
| 35- 60 | 4 13/16" | 1⅝" | 2⅛" | 2½" | 2⅝" | 3 " | 2½" | 2½" | 2 " |
| 65-100 | 6⅞" | 1½" | 2¼" | 3¼" | 2⅝" | 3¼" | 2¾" | 3 " | 2¼" |
| 110-200 | 8¼" | 1⅞" | 2½" | 4 " | 3 " | 3⅜" | 3 " | 3⅜" | 2⅝" |
| 225-400 | 9⅜" | 2½" | 2¾" | 5¾" | 3½" | 4½" | 3⅜" | 5 " | 3½" |
| 450-600 | 11⅛" | 2⅝" | 3 " | 7 " | 4¼" | 5¼" | 3⅝" | 6½" | 3½" |
| 650 | .... | .... | .... | .... | .... | .... | .... | 6½" | 3¾" |
| 850 | .... | .... | .... | .... | .... | .... | .... | 7½" | .... |

COPPER SIZES FOR MAINS AND BRANCH BARS.
1,000 Amp. Rating.

| Amperes | 30 | 60 | 100 | 150 | 200 | 300 |
|---|---|---|---|---|---|---|
| Copper sizes | ⅛x⅛" | ⅝x⅛" | ¾x3/16" | 1x3/16" | 1x¼" | 1¼x¼" |
| Amperes | | 400 | 500 | 600 | 700 | 800 |
| Copper sizes | | 1¼x⅜" | 1½x⅜" | 1½x½" | 2x⅜" | 2x7/16" |

For total wire we have:

Equation No. 1.....1318′ No. 14 Duplex.
Equation No. 2.....1410′ No. 14 Duplex.

2728′ No. 14 Duplex.

Plus allowance for small loops at outlets and at cabinets.

For conduit we have:

Equation No. 1.....1318′ ½″ conduit.
Equation No. 2.

Assume the home runs are divided into the following percentages:

1½″ conduit with one circuit.....10%
¾″ conduit with two circuits.....40%
1″ conduit with five circuits.....50%

3....½″ home runs 3 circuits total.
6....¾″ home runs 12 circuits total.
3.... 1″ home runs 15 circuits total.

30 circuits.

$3 \times 40 = 120'$ of ½″ conduit $+ 3 \times 7 = 141'$.
$6 \times 40 = 240'$ of ¾″ conduit $+ 6 \times 7 = 282'$.
$3 \times 40 = 120'$ of 1″ conduit $+ 3 \times 7 = 141'$.
Total conduit....1318′ + 141′ = 1459′ of ½″.
Total conduit....282′ of ¾″.
Total conduit....141′ of 1″.

PLAN NO. II.

Applying Equation No. I.

45....300-watt outlets.
Cabinet D....11 circuits.
Cabinet E....12 circuits.

23 circuits total.

$A = (40 \times 60) + (60 \times 60) + (200 \times 60) = 18{,}000$ sq. ft.
$\sqrt{A} \div B = \sqrt{18{,}000} \div 45 = 20$.
$C \times B = 20 \times 45 = 900$ feet.

Applying Equation No. II.

Cabinet D.

$0.6\sqrt{80^2 + 60^2} = 60$.
$0.6\sqrt{40^2 + 80^2} = 54$.
$0.6\sqrt{40^2 + 40^2} = 34$.
$0.6\sqrt{40^2 + 60^2} = 43$.
$(60 + 54 + 34 + 43) \div 4 = 48$ average $G$ for Cabinet D.

Cabinet E.

$0.6\sqrt{60^2 + 40^2} = 43$.
$0.6\sqrt{60^2 + 60^2} = 51$.
$(43 + 51) \div 2 = 47$ average $G$ for Cabinet E.
$(48 + 47) \div 2 = 47\frac{1}{2}$ average $G$.

Wire.

By Equation No. I.....900′ of No. 14 Duplex.
Plus $45 \times 1$ 45′

945′ of No. 14 Duplex.

By Equation No. II:
(assume 12′ ceiling)

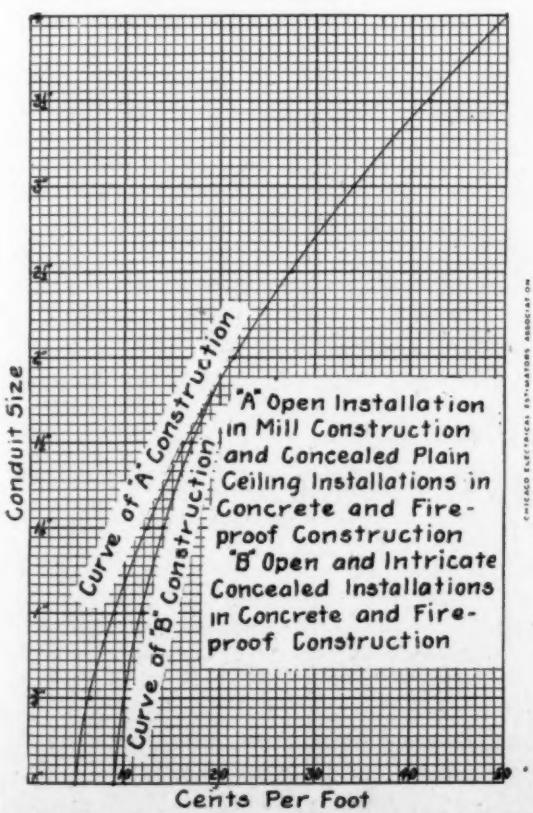
$23 \times 47\frac{1}{2} = 1093'$
$23 \times 7 = 161'$

1254′ of No. 14 Duplex.
Plus above 945′

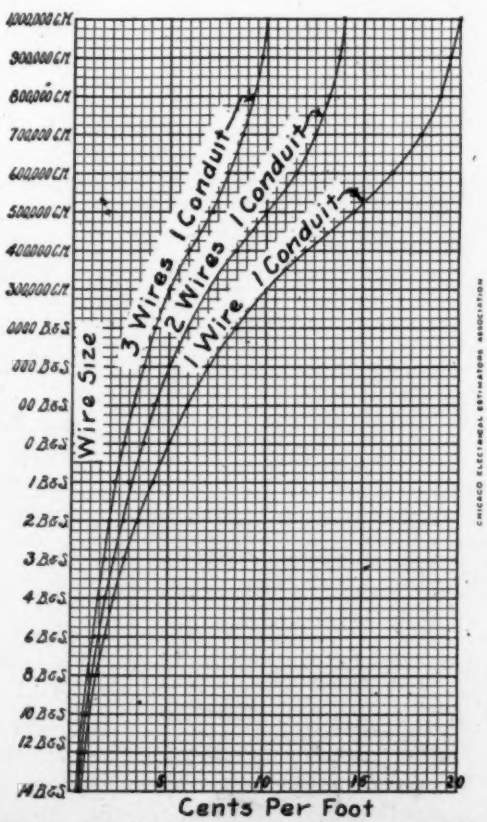
2199′ of No. 14 Duplex.

Conduit.

By Equation No. I: 945′ of ½″.
By Equation No. II:
Assume 3 home runs, ½″—one circuit each.
Assume 10 home runs, ¾″—two circuits each.
$3 \times 47\frac{1}{2} + 3 \times 7 = 164'$ of ½″.
$10 \times 47\frac{1}{2} + 10 \times 7 = 545'$ of ¾″.
Total conduit: $945 + 164 = 1109'$ of ½″.
545′ of ¾″.


Conduit Size
Curve of "A" Construction
Curve of "B" Construction
"A" Open Installation in Mill Construction and Concealed Plain Ceiling Installations in Concrete and Fireproof Construction
"B" Open and Intricate Concealed Installations in Concrete and Fireproof Construction
Cents Per Foot

These Curves Indicate an Average Labor Unit for Installing Conduit Under Average Working Conditions.




These Curves Indicate an Average Labor Unit per Foot of Wire to Pull Same in Conduit.

# Editorial Comment

## Scientific Estimating in Electrical Contract Work

ESTIMATING by electrical contractors has remained one of the worst examples of the loose business methods still largely in vogue in that unhappy fraternity so much beset by irritating ills. The frequent absence of cost systems has made it almost impossible for many contractors to know what was their actual cost of installing work of different kinds, so that at best a large percentage of the bids submitted on the average prospective jobs were wild guesses instead of careful estimates. In some cases an intentionally below-cost bid was presented in order to insure taking a job away from a competitor, the hope being entertained that the almost certain loss would be offset by well padded extras or an inferior installation. In most cases, however, the estimate was free from intentional underbidding or deception, but was still a more or less haphazard piece of guesswork. Many contractors based their bids on the ripened experience of many years and, if they possessed good judgment and had carefully studied and checked the plans and specifications, they were able to arrive at a pretty fair estimate of what the actual cost would be. Others were guided largely by what they called having a "hunch" respecting the amount of work and special difficulties involved. In very few cases was a scientific estimate made.

Obviously, where the amount involved in a prospective contract was large, it was too hazardous a matter to risk to loose estimating the preparation of a bid. Therefore the large contracting firms made careful studies of the matter and of course gathered a mass of data to guide in the preparation of future estimates. There was still much variation in the schemes followed in making the estimates, however, so that the amount of the bid was frequently affected by the basis and system of estimating chosen. As the result of the better co-operative feeling developing in the electrical contracting fraternity and the gradual disappearance of violent jealousies and ruinous competition, the estimators of the leading contractors in Chicago gathered to discuss their problems and try to develop a scientific system of estimating. This has been done very successfully and numerous valuable data have been compiled, particularly on labor costs, an element of construction costs on which there has been a woeful lack of reliable information.

The most valuable report on scientific estimating and the most comprehensive collection of data on the labor cost of electrical installation work in average building interiors that has yet been prepared was presented at last week's annual convention of the National Association of Electrical Contractors and Dealers at Cleveland, Ohio. The Association voted to publish and copyright the report and distribute it to all its members. Through the courtesy of its Executive Committee we are permitted to reproduce this excellent report in full on other pages of this issue.

The report represents the joint effort of the Electrical Estimators' Association of Chicago and was presented at the Cleveland meeting by its secretary, John R. Smith. It discusses the various steps that must be taken in the preparation of an estimate and how to check quantities, it gives as examples the detailed calculations of two typical estimates and shows how the estimate should be tabulated and summarized, and finally it presents several curves and nearly a score of tables of labor cost data. The keen interest taken in the presentation of this report shows the general appreciation by the electrical contractors of its value to their industry. Although costs of materials are readily determined from catalog list prices and discount sheets, the labor cost has always been the greatest uncertainty in preparing an estimate. The report presents for the first time a comprehensive compilation of labor data for the principal classes of work met with, giving both time and cost, the latter based on the present Chicago scale, $7.00 per day.

While these data are subject to revision to meet different conditions existing in different communities, especially as to the labor rate, they represent the best and most complete study of this most important subject yet made. The report as a whole is one of the first examples of the valuable constructive work now beginning to be developed as a result of the reorganization and co-operation in the electrical contracting fraternity during the past year. May this be but the forerunner of countless other examples of constructive and co-operative effort for the upbuilding of this formerly much maligned branch of the electrical industry.

## Shots in a Long War

THE President has taken over the telephone and telegraph lines, effective midnight, July 31, for the duration of the war. The Government had enough to take care of before, what with the food and fuel, railroads and industries, but insurance against strikes and obstructions and assurance that the most important means of communication next the railroads, covering even a greater territory, should remain unhampered has necessitated the step.

The turbine industry has also been taken over by the Government, a necessary step in speeding up the

production of prime movers for marine work, federal plants throughout the country, and necessary extensions to other needed plants. Taking over the turbine industry probably means that the condenser industry will follow suit, part and parcel as it is of the turbine, although not necessarily so. Already the country has been sorely taxed in meeting the needs of the battleships, cruisers and merchant marine for surface condensers. With turbine production and distribution under Government control, one looks almost instinctively to the restricted use of surface condensers on land. Steel tubes may be expected to replace those of alloy, and the barometric or jet condenser may be expected to supplant the surface type for land service wherever feasible.

Industrial and power plants are linking up and sharing their loads. Isolated plant and central station, past enemies, are linking up to save fuel and increase capacity. Trade and business is being pooled, where not long since the same things would have been called monopoly or restraint of trade. Lightless nights have come again. Each of these is of enormous importance, happenings that a few years ago would have been heralded with alarm and wonder by both capital and labor. Today they are but incidents, and pass almost unnoticed, or call for but passing and brief comment. They are stepping stones, necessities for victory, shots in a long war.

With occasional sinkings of ships outside our ports; the sporadic dropping of shells along our coasts, the first for more than one hundred years; with the Stars and Stripes and our sons and brothers at the front and in the thick of the fight; with the casualty lists lengthening day by day and stars of gold intermingling with those of blue, comes the realization that the war is coming closer and a sterner reality. But we are in the war until we have won it, and each step taken as necessary for winning the war quicker and the less expensively in life and treasure is a step in which we all acquiesce for the common good.

## *Evolution of the Small Boiler Room*

BOILER room instruments have received pleasing publicity of late. But more pleasing is the tendency to modernize the boiler room and make it what it might be, but so rarely is.

The presence of instruments gives a boiler room social standing, always desirable, but of particular importance at this time. However, it is only by efficient operation, intellectual interpretation of what these instruments show, that fuel economy and economical operation can be maintained. And it is only then that the investment in apparatus and equipment brings in a worthy return.

The old impression that boiler room instruments were installed to catch the men loafing has passed. Today the boiler room force realize the need for knowing what they are doing and how doing it. Moreover, they find, in ninety-nine cases out of a hundred, that the instruments enable them to get better results while making less effort.

It is not enough to install boiler room instruments, they must be understood, and the men must be able and desirous of using them. Knowledge takes time, and the man with knowledge is worth more than the man without. Yet many companies allow men to leave them, when they have learned what the company has to teach rather than raise their pay. This is indeed a shortsighted policy, since as a man learns more he becomes worth more.

An employe becomes worth more as he does better work, and a healthy incentive for better work is conducive to better sustained results. The bonus, in any of its multitudinous forms, deserves especial attention at this time, when so much need exists for obtaining best results, and attracting and keeping personnel. Nothing appeals to a conscientious worker more than the knowledge that his conscientiousness is appreciated in a practical way, and the only practical way is higher remuneration.

The small plant, that has proverbially lagged behind the larger ones, is finding it no longer profitable nor possible to go on in wasteful and inefficient ways, with the excuse that it is not justified in becoming efficient because too small. If not justified in being efficient it is not justified in remaining in existence. Save coal or have none is fair and wise dictum. Today boiler room instruments find justification in many small plants on economic grounds, which was not the case a couple of years ago. Conditions have changed, as have also the instruments. The old theory that it did not pay to put mechanical stokers under boilers of less than several hundred horsepower is also fading, high fuel prices and scarcity of labor have exploded the old-time creed. There is great need for small stokers for the small boiler of 100 horsepower and thereabouts. In passing, the small steam turbine, now available in capacities from about 10 horsepower and up gives the small plant a different aspect, and opens up a field for results superior to those usually encountered in the way of auxiliary drive as well as prime movers.

The ability and performance of the human element is well known. The tendency is to give the boiler room attendants less to do rather than more to do. Many functions now performed manually could be performed mechanically, and done more cheaply with greater uniformity. The economical boiler room of today is the boiler room that uses mechanical apparatus adapted for efficient performance where possible. The human element is too variable.

If the small plant is to remain, and there are instances galore where it is economically sound, it must change in keeping with the standards of the day. Men must not do what machines can do better and faster, performance must be indicated and recorded instead of being done in the dark. The small plant, as the large plant, must be a business proposition or be wrecked on the rocks of elimination.

# Week's Events

## *Important Topics Discussed by Contractors and Dealers at Cleveland — New Light Restricting Order in Effect*

### CONTRACTORS AND DEALERS MEET IN CLEVELAND.

**Eighteenth Annual Convention Held at Hollenden Hotel. Important Topics Discussed.**

The first annual convention of the reorganized National Association of Electrical Contractors and Dealers was held at the Hollenden Hotel, Cleveland, Ohio, July 15 to 20. This meeting, although the first since the reorganization meeting at New Orleans last October, was the eighteenth national convention of electrical contractors. The attendance of well over 300 was a surprise to those prominent in association affairs and has been exceeded only by two previous conventions of the association. The interest manifested by those present was convincing proof of the importance of the movement in the industry to stabilize conditions in accordance with the Goodwin Plan.

Although the field of the contractor-dealer has been disturbed to perhaps a greater extent than that of any other branch of the electrical industry because of war conditions, the new association has made wonderful progress both in work accomplished and in acquiring new members, and the success of the movement is definitely assured.

The convention was formally opened on Wednesday morning, July 17, being preceded by a meeting of the Executive Committee on July 15 and 16, at which routine association matters were discussed. Among the many interesting topics on the program were two which predominated because of their timely importance. One was that of estimating and the other the subject of merchandising. In connection with the subject of estimating, the contractors are well aware that there has been little or no standardization in this respect and that many of the ills of the industry have been due to improper methods of estimating and cost keeping. The principal discussion was presented by John R. Smith, secretary of the Chicago Estimators' Association, who presented a very comprehensive report on the work of this organization in arriving at labor and material costs in bidding.

The question of retailing electrical appliances was presented in a very interesting manner by R. E. Flower, of the Erner Electric Company, and later in a report by the Merchandising Committee of the association of which Fred Adam, of St. Louis, Mo., is chairman. Contractors and dealers now fully appreciate the importance of this field and many of those who have previously conducted an exclusive contracting business are planning to enter the retail field. Definite suggestions were offered in both the paper by Mr. Flower and the report of the committee.

W. L. Goodwin, who as author of the Goodwin Plan was first instrumental in having the association reorganized and later in actually affecting this reorganization, delivered an address at one of the sessions, which was in a sense an answer to some of the criticism which has been made regarding various features of the Plan.

The convention was opened by A. L. Oppenheimer, president of the Electrical Contractors' Association of Cleveland, who on behalf of that organization welcomed the convention to Cleveland, and urged contractors to always keep in mind that the winning of the war was the most important business before us and in this contractors can play an important part.

A representative of Mayor Harry L. Davis extended an official welcome and an appropriate response was made by W. C. Peet, of New York, national chairman of the association. Mr. Peet briefly reviewed the reorganization that had taken place in the association and called attention to some of the new policies which have been inaugurated, particularly that of holding open meetings to which the public is welcome.

An address on the subject of "Enthusiasm," was delivered by William G. Rose, of the Cleveland Advertising Club, in which he eloquently conveyed the message that enthusiasm was one of the vital factors for success. This address was followed by a few remarks by Earnest McCleary, of Detroit, national treasurer, in which he spoke of confidence as being a prime requisite in these times not only in regard to personal and business affairs, but also national.

The concluding feature of the morning session was the presentation to William L. Goodwin of an engrossed gold and leather testimonial on behalf of the electrical contractor-dealer associations of Greater New York, the merger of which had been accomplished by Mr. Goodwin. The presentation was made by G. M. Wheeler, of New York, who further suggested that Mr. Goodwin be voted an honorary member of the National Association of Electrical Contractors and Dealers. This was unanimously carried by rising vote.

#### Labor and Material Costs.

At the afternon session, E. E. Van Cleef, of Chicago, presented a paper entitled "A Proposed Scientific System of Wage Adjustment," by L. K. Comstock, president of the L. K. Comstock Company, of New York. This paper deals at some length with the labor situation under war conditions and takes into recognition the fluctuating costs of living and proposes that wage adjustments should be made in accordance with these fluctuations, either upward or downward. E. D. Sickles presented the paper on "Unit Labor Costs" prepared by F. W. Lord, of New York, which describes a system of reports on productive and unproductive labor costs.

John R. Smith, on behalf of the Chicago Estimators' Association, presented a paper on "Estimating," which was considered by many the most instructive discussion ever brought before the electrical contractors. This paper, which is a combination of the ideas and practices of many estimators connected with prominent Chicago contractors, is presented in practically

complete form elsewhere in this issue. In deciding to reprint this paper for distribution among the members of the association, it was brought out in the discussion that the idea was not to offer the methods advanced for adoption literally by all members but simply as a first step toward securing some sort of standardization. It was pointed out by Earnest McCleary, of Detroit, that in one or two instances, the methods suggested would not be permissible under the National Electrical Code.

### Features of the Goodwin Plan.

The principal feature of the session on Thursday morning was the address of W. L. Goodwin on the Goodwin Plan, in which he presented his plan in the form of 21 planks in order that the matter might be brought more specifically before the industry. These planks, in the order referred to, are as follows:

(1) A strong and representative association of electrical contractor-dealers (retailers) and urges all interests to lend immediate assistance to this end.

(2) That each division of the industry prepare a code of ethics outlining its own functions, relations and responsibilities to each of the other divisions of the industry.

(3) That each division establish a code of practice outlining its methods, policies, etc., in dealing with other than divisions within the industry.

(4) Improvement in merchandising methods, better display, and the encouragement of more retailers, by urging present contractors to open retail stores, thereby enlisting the support of central stations and offering a broader and larger outlet for manufacturers.

(5) Recognition of the service functions of the contractor-dealer and recommends a differential when this service is performed.

(6) The sale of high-grade electrical material; the establishment of high-class specialty retail shops; improved specifications in wiring installations; and the introduction of liberal use of convenience receptacles.

(7) Broader education of the public concerning the problems of the electrical industry, and concerning electricity, its use, and the application of household devices.

(8) Retailers applying intensive sales methods in connection with small devices used in home, factory, office, etc. (such as washing machines, vacuum cleaners, dishwashers, electric ranges, electric heaters, household heating devices, sewing machine motors, fans, lamps, portables, fixtures, vibrators, hair dryers, ice machines, etc.).

(9) The introduction and application of proper cost-accounting methods in wholesale and retail merchandising, particularly if either function is a minor department of a company.

(10) Free and unobstructed flow of trade along most economic channels, without attempt to direct it through fixed channels.

(11) That central stations conduct retail departments for the sale of lamps, appliances, devices, portables, etc., and operate same in accordance with the ethics of retailing and with full regard to proper cost accounting.

(12) That all interests conduct retail departments, to be operated at a profit. The adoption of this policy on part of central stations and jobbers will result in a large number of concerns entering the retail field.

(13) Recognition of the service function of jobbers in the distribution of supplies and recommends a differential when full service is performed, and a proportionate differential when only a partial service is rendered.

(14) Jobbers determining, through proper cost accounting, the cost of warehousing, and selling their principal commodities, to the end that each principal commodity will carry its proper portion of overhead.

(15) Open meetings of all trade associations, including meetings of executive committees.

(16) That the electrical press become an integral part of each division by honorary or associate membership, and that unrestricted publicity be given the proceedings of all meetings.

(17) The formation of a national lecture bureau, with state and local staffs. The function of the staff would be to carry on educational work within the industry and before public gatherings. Service to be gratuitous.

(18) Recognition of the principle that any action taken by a single division which affects another division is seldom satisfactory unless each division affected is represented.

(19) The appointment of committees by the National Electric Light Association, Electrical Supply Jobbers' Association, National Association of Electrical Contractors and Dealers, and various manufacturers' associations to meet together to study the problems of the industry and to co-operate in finding their solution.

(20) Consolidating or reconstructing overlapping organizations. A committee comprising representatives from each association should be formed to study this question and submit a plan.

(21) Eventually a single organization in the electrical industry, consisting of national, division, state and local sections; also main national sections for the solution only of functional problems of the several branches or groups.

The afternoon session was held in the outdoor recreation camp at Nela Park, following a very enjoyable luncheon in the dining rooms as guests of the National Lamp Works of the General Electric Company. At this session, Sullivan W. Jones, Washington representative of the association, pointed out the work which is being done in Washington and referred to the efforts that are being made to have work let on a sub-contract basis.

This address was followed by the paper, entitled, "Industrial Application of Electricity," by D. E. Miller, of the Society for Electrical Development. The paper deals at some length with the opportunities in the industrial electric heating field. A more extended reference to this paper will be presented in a later issue.

On Friday morning, James R. Strong presented the report of the committee on proposed changes of the national constitution and by-laws, which related particularly to minor modifications which have been shown necessary in the light of experience of the last months under the new regime. This was followed by a report of the Committee on Credit and Accounting by J. E. Sweeney, chairman, in which was pointed out that efforts are being made to standardize accounting and forms will be prepared and issued from time to time.

### Merchandising Suggestions.

The principal feature of this session was the paper by R. E. Flower, manager of the household appliance department of the Erner Electric Company. This paper emphasizes the fact that business in the appli-

ance field was never better than today, for the contractor who is considering entering this field need not feel that elaborate furnishings are necessary for a retail store. The experiences of successful retailers in other industries should be a lesson to electrical dealers and the same good business methods should be applied. Mr. Flower spoke particularly of the excellent opportunities which were afforded dealers in handling labor-saving devices which are today of such importance. These should be prominently displayed in the store and standard goods given less prominence. A more complete report of this paper will be given in a later issue.

At the final session on Friday afternoon a very interesting paper, entitled, "Engineering Features Essential to Success of Farm-lighting Business," was presented by Evan J. Edwards, of the National Lamp Works of the General Electric Company. Mr. Edwards emphasized the tremendous importance of this field and stated that farm-lighting plants are not in competition with central-station service but are intended for use only in such localities where it is impossible to purchase power. He said that they are not cheaper and should not be recommended for heavy motor service. They will give their best results when used for lighting only. Mr. Edwards dealt with the question of standardization, which he thought an essential factor, particularly in regard to voltage.

George E. MacIlwain, of the Babson Statistical Organizations, delivered a very interesting address, entitled, "Real Causes of Prosperity and Depression," in which he dealt particularly with the labor situation and the tendency toward utilization of labor. This tendency is fast becoming appreciated by employers.

The final feature of the meeting was the question box discussion by Mr. Goodwin at which he answered unsigned questions proposed by various delegates in attendance.

## FUEL ADMINISTRATION'S NEW LIGHT-RESTRICTING ORDER NOW IN EFFECT.

### Outdoor and Display Illumination to Be Discontinued On Certain Designated Nights Each Week.

The United States Fuel Administration's recent order, restricting the use of fuel for outdoor illumination and establishing new "lightless" nights, went into effect July 24.

The Bureau of Standards of the Department of Commerce has advised the Fuel Administration that it is estimated that about 500,000 tons of coal per year is used for advertising purposes, including display and show-window lighting in the United States. Similar estimates fix the amount of coal used in advertising lighting in New York City at 16,000 tons per year.

With the miners of the country responding loyally to the appeals of the Fuel Administration for increased production, the weekly output of bituminous coal is surpassing all previous records. The efforts of the Fuel Administration, operators, and miners to increase production must be supplemented, however, by the elimination of every wasteful or unnecessary use of coal. The enormous war demand for fuel makes it imperative that the country make the most economical use possible, even of the constantly increasing output.

The order restricting lighting reads:

It appearing to the United States Fuel Administrator that it is essential, in furtherance of the national security and defense, the successful prosecution of the war, and the support and maintenance of the Army and Navy, to lessen and prevent the waste of fuel, and to secure an adequate supply and equitable distribution and prevent, locally and generally, scarcity thereof, and that to these ends, it is necessary that the use of fuel shall be limited and restricted in the manner hereinafter set forth.

The United States Fuel Administrator, acting under authority of an executive order of the President of the United States, dated August 23, 1917, appointing said administrator, and of subsequent executive orders and in furtherance of the purpose of said orders and of the act of Congress therein referred to and approved August 10, 1917,

Hereby adjudges that in his opinion the use of fuel or of light generated or produced by the use or consumption of fuel for any of the purposes hereinafter described, except as hereinafter provided, is wasteful, and that any person using fuel or light for such purposes, except as aforesaid, is engaging in a wasteful practice or device in handling or dealing with fuel, and that the use of fuel or light for such purposes except as aforesaid is prejudicial and injurious to the national security and defense, and a cause of scarcity, locally and generally, and said United States Fuel Administrator hereby orders and directs that, until further or other order of the United States Fuel Administrator, and subject to modification hereafter from time to time, and at any time,

1. No city, village, or town and no person, firm, or corporation under any contract with any city, village, or town, shall use or consume any coal, oil, gas, or other fuel for the maintenance of lights in the streets, parks, or other public places of such city, village, or town, except under the following restrictions and limitations.

(a) Street illumination automatically lighted, maintained by or for any such city, village, or town, in the streets, parks, or other public places thereof, shall not be lighted before sunset and shall be turned out not later than sunrise;

(b) Street illumination lighted by hand in any such city, village, or town shall conform as nearly as may be to the requirements hereinabove prescribed for automatic lights;

(c) The amount of public lighting in any city, village, or town shall be only so much as may be necessary for safety, and the use of lights commonly known as cluster lights for purposes of display or decoration shall be reduced to such portion only of the cluster as is necessary for safety.

2. The local fuel administration for the territory within which any city, village, or town is located shall arrange with the proper municipal or town authorities of such city, village, or town for the regulation of public lighting in accordance with the provisions of paragraph Number 1 of this order. Regulations for public lighting so arranged shall in each case be subject to the approval of the proper State Fuel Administrator, and in case regulations in accordance with said paragraph 1 for the public lighting of any city, village, or town, satisfactory to the State Fuel Administrator of the State within which the same is located, shall not have been arranged between the local fuel administration and the proper municipal or town authorities as hereinabove provided, within ten (10) days from and after the effective date of this order, said State Fuel Administrator is hereby authorized and directed to prescribe such regulations for such city, village, or town, and the same shall be valid and binding.

3. Outdoor lights within a city, village, or town, other than those mentioned in paragraph 1 of this

order, which involves, directly or indirectly, the use or consumption of coal, oil, gas, or other fuel shall not be lighted until 30 minutes after sunset.

4. (a) The use of light generated or produced by the use or consumption of coal, gas, oil, or other fuel for illuminating or displaying advertisements, announcements, or signs, or for the external ornamentation of any building shall be entirely discontinued on Monday, Tuesday, Wednesday, and Thursday of each week within New England and the States of New York, Pennsylvania, New Jersey, Delaware, Maryland, and the District of Columbia and shall be entirely discontinued on Monday and Tuesday of each week in all the remainder of the United States.

Exception: Bona fide roof gardens where meals are served and outdoor restaurants, also establishments devoted exclusively to the exhibition of outdoor moving pictures at which admission is charged are exempt from this section.

4. (b) The use of light generated or produced by the use or consumption of fuel for illuminating or displaying any shop windows, store windows, or any signs in show windows shall be discontinued from sunrise to sunset and shall also be discontinued on the nights specified in paragraph 4 (a).

5. The State Fuel Administrators within the several States are hereby directed and authorized to see that the provisions of this order are observed and carried out within their several States, to report violations thereof to the United States Fuel Administrator, and to recommend to him action to be taken with respect to such violations.

This order shall be effective on and after July 24, 1918.

## CONFERENCE CLUB HOLDS EIGHTH MEETING AT SCHENECTADY.

**Important Papers Presented—New Plans for Co-ordination in Electrical Industry.**

The eighth meeting of The Conference Club was held at Schenectady on July 21 to 24, to which electrical manufacturers, jobbers and consulting engineers were invited, as guests of the General Electric Company.

Among the papers presented were those of Sullivan Jones on "A Functional Reorganization of the Electrical Industry"; and by E. Ellinger of the L. K. Comstock Company on "Credits." Mr. Jones' paper covered in general the main points brought out by him at a meeting of this Club at Asheville, on April 25. Mr. Ellinger reviewed the plan of establishing a more generally recognized system of credits, calling attention to the fact that such a plan must recognize the wide variation in the class of products sold and the demands of distribution, so that credit policies which applied to heavy machinery might not be confused with policies in sales of supplies.

In the paper by Mr. Jones, outlining a "Functional Reorganization of the Electrical Industry," he took up a plan proposed by the Conference Club under which the manufacturer, contractor and consulting engineer will each be afforded an opportunity to develop his full usefulness, leading to the contractor becoming a consulting engineer. The mind of the world is changing, he said, as regards many of the fundamentals of life, amounting to a rapid evolution, bringing us to think more of our duties than our so-called rights. This change is creating greater respect for co-ordinate thought and co-operative action, and develops the forward-looking habit of mind which gives consideration to present things mainly in relation to results. The cause of humanity has forced us to think in unified terms, and to grasp the idea that industrial efficiency results from highly developed. co-operative effort, inspired by loyalty to a common cause. Under this, each individual works because he wants to, and not because he has to.

He then showed that there was lacking in the electrical industry a community of interest; that all factors therein were not working harmoniously. This was followed by the discussion of a plan for co-operation by working in an invigorating atmosphere of mutual respect and confidence between individuals and between class and class. The first step is the creation of an instrument representative of all the functional groups in the industry, and for joint deliberation on problems common to all groups.

The proposed reconstruction plan for the electrical industry contemplates consideration for the interests of all elements—the manufacturer, jobber, dealer, contractor, employe, and the engineer and investor. The interests of all these are closely related and inter-dependent. Then he discussed the necessity for harmony in the movement of goods from manufacturer to consumer without waste of energy and with proper consideration for all concerned.

## LARGE CAPACITY POWER PLANT COMPLETED AT CHESTER, PA.

**Delaware County Electric Company Will Have 80,000 Horsepower Available by September 1.**

The Waterside station of the Delaware County Electric Company, located on the Delaware River, at Chester, Pa., has been about completed and is to be placed in operation by September 1. The equipment is housed in a structure of steel and concrete.

An area of about 23 acres is covered by the station grounds, which have a river frontage of 620 feet with coal and ash docks.

The building and floor space provide for an ultimate capacity of 160,000 horsepower, the initial installation, however, is for 80,000 horsepower. The coal yards have facilities for handling and storing 100,000 tons of coal.

The steam power installations consist of eight 1500-horsepower boilers, with provision for double that number when the ultimate capacity of the plant is reached. The coal is fed by mechanical stokers, each operated by an individual motor. The ash is ground by specially-designed, motor-driven clinker grinders, and discharged into hoppers, from which it may be loaded into cars.

The turbogenerators are the Curtis horizontal type, having all the modern accessories. The outgoing currents are conducted through enclosed passageways to the main switch house, containing the control desks, switching panels and busbars. Each individual switch is built in a concrete cell, and connections between busbars and switches, and outgoing feeders are protected by fireproof barriers.

Energy produced here will be transmitted at 13,200 volts to power and lighting substations in Chester and throughout Delaware County; also to munition plants and shipyards along the Delaware River, and to various trolley systems. This system is connected to that of Philadelphia Electric Company by a 66,000-volt transmission line, carried on steel towers.

# Operating

## *Weights of Various Coals—Novel Meter Problem—Color of Transformer Case Affects Capacity—Lighting Table*

### WEIGHT OF VARIOUS COALS.

**Valuable Data on the Effect of Wetting and Shaking on Weight Published by Bureau of Mines.**

Most people realize that various grades of coal have different weights, but to what extent they actually vary has not been authoritatively stated in a way that is readily accessible, however. The specific gravity or weight of anthracite coal compared with an equal volume of water is given as 1.4 to 1.8, of bituminous coal as 1.2 to 1.5, of lignite 1.1 to 1.4, by Marks, who also states that 97, 84 and 78 pounds are the respective values of the fuels per cubic foot.

These figures are useful, the Bureau of Mines points out in its Technical Paper No. 184, entitled, "Weights of Various Coals," in computing the amount of coal in the ground, but most engineers more probably want to know the weight per cubic foot of broken coal as delivered or stored. Variations in weight of solid coal, obviously, affect the weight of the coal delivered, and one naturally expects a cubic foot of lignite to weigh less than a cubic foot of anthracite. Factors other than specific gravity enter the problem, however, among which are quantity of surface moisture, proportions of coarse and fine coal, and amount of shaking or settling.

The above technical paper reaches the following conclusions, based upon tests:

(1) Of two samples of any coal that are composed of the same proportions of pieces of different sizes, the sample having the higher moisture content will usually weigh the more per cubic foot.

(2) The sample of higher moisture content will usually occupy more space for the same number of pounds of (dry) coal than will a sample of lower moisture content. However, the increase in volume for the wet coal is not as great proportionately as is the increase in weight per cubic foot.

(3) Coal shoveled loosely into a container will settle appreciably if the container is shaken, and the weight per cubic foot will be correspondingly increased.

(4) Slack coal composed of a mixture of the smaller pieces up to and including nut size weighs more than screened nut coal.

This last statement coincides with the conclusions drawn from experiments with concrete mixtures, which have shown that a much denser mixture can be made by using certain proportions of various sized pieces. Pieces of nearly uniform size when piled leave about 45 per cent of voids. If these spaces are filled with finer coal of uniform size, the weight of the mass is increased and the interstices in the finer coal can again be filled with still finer pieces, resulting finally in a dense mass. It is evident, therefore, that the relative proportions of fine and coarse material have a considerable influence on the weight per cubic foot of the mass.

### COLOR OF TRANSFORMER CASE AS AFFECTING CAPACITY.

**Discussion of Relative Advantages of Dark and Light Colors for Transformer Cases.**

By H. M. Daman.

With the larger capacities coming into vogue; the increasing number of installations of outdoor apparatus springing up at present, which may be expected to increase materially after the war because of the construction of rural lines and interconnection; the greater use of the outdoor installation because of its lower unit cost and simplicity, there is one subject which the writer believes might to good advantage be given more consideration than it apparently receives. That subject is one concerned with the choice of color of the transformer casings, and of such structures as outdoor metering houses, etc.

Theoretically, the output of a transformer, as governed by internal temperature, should be influenced by the color with which the external surface of the case is painted. The heat radiated by a black body is dif-

Table of Changes in Weight or Volume of Coal by Wetting and Shaking.

| | Dec. 13 1915. Nut. | Dec. 13, 1915. Slack. | Dec. 16, 1915. Nut | Dec. 16, 1915. | Jan. 20, 1916. | Jan. 21, 1916. | Jan. 22, 1916. | Jan. 24, 1916. | Jan. 25, 1916. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Slack (a) | | | |
| Weight of 8 cu. ft. of coal in original condition (lbs.) | 351.5 | 393 | 363 | 372 | 388 | ..... | ..... | ..... | ..... |
| Weight of 8 cu. ft. of same coal after wetting (lbs.) | 364.5 | 419 | 370 | 393 | 416 | 392 | 388 | 386 | 388 |
| Settling when shaken (inches) | ..... | ..... | ..... | ..... | 1 | 1½ | 1½ | 2 | 1½ |
| Total weight of original 8 cu. ft. of coal moist condition (lbs.) | 364.5 | 426 | 371 | 408 | 421 | 396 | 391 | 389 | 388 |
| Moisture in coal in original condition (per cent) | b1.5 | b2.5 | 1.85 | 2.13 | 3.26 | ..... | ..... | ..... | ..... |
| Moisture in wet coal (per cent) | 5.0 | 9.6 | 3.97 | 10.76 | 10.8 | 5.20 | 3.99 | 3.50 | 3.26 |
| Weight of coal per cu. ft. in original condition (lbs.) | 44 | 49.1 | 45.4 | 46.5 | 48.5 | ..... | ..... | ..... | ..... |
| Weight of moist coal per cu. ft. (lbs.) | 45.6 | 52.4 | 46.3 | 49.1 | 52.0 | 49.0 | 48.5 | 48.25 | 48.5 |
| Increase in weight of unit volume of coal through wetting (per cent) (c) | 3.64 | 6.72 | 1.98 | 7.74 | 7.22 | 1.03 | 0 | d0.51 | 0 |
| Volume of original 8 cu. ft. of coal in moist condition (cu. ft.) | 8.00 | 8.134 | 8.022 | 8.306 | 8.10 | 8.082 | 8.062 | 8.062 | 8.00 |
| Increase in volume from increase in moisture (%) | 0 | 1.67 | 0.27 | 3.8 | 1.24 | 1.02 | 0.77 | 0.78 | 0 |
| Reduction in volume from shaking (per cent) | ..... | ..... | ..... | ..... | 4.2 | 6.25 | 6.25 | 8.34 | 6.25 |

a Determinations of Jan. 20-25, 1916, were made with the same sample of coal. This coal was wet on the 20th and exposed to the atmosphere.
b Moisture assumed.
c Volume obtained by shoveling the coal loosely into a box measuring 2 feet by 2 feet by 2 feet and leveling off with a straight-edge.
d Decrease.

ferent to that radiated by the same body painted white. The same applies to heat absorbed. A black body more readily radiates heat from within than does a light body. But it also absorbs heat more readily than a body of light color. Ordinarily, outdoor transformers are painted a dark color because by so doing the apparatus is made less conspicuous than were the color light, the paint is cheaper, and when once painted, the case may be left alone without further concern, since the dark coloring does not show dirt, etc. However, it seems that under certain circumstances it might be preferable to employ a light-colored paint rather than a dark one, depending upon the load and the climatic conditions.

It is usually considered that the influence of radiation of heat outward is of greater importance than the absorption of heat from the exterior, and for this reason the use of a dark exterior is preferable. The color should, however, depend upon local conditions, and the load, whether occurring during the day or night, and whether the most important thing is radiation of heat from the inside out or absorption of heat from the outside in.

In intensely hot climates with transformers exposed to the sun's rays for long periods daily, the writer has encountered a number of transformer burnouts from no apparent cause, that later were found to be due to the continuous maintenance of excessive temperatures, although the load was by no means continuous and constant. The explanation advanced was that the heat absorbed by the black cases was responsible for the high temperature. In such instances employing a light-colored case deserves consideration. This matter becomes of even greater importance in clear atmospheres where the effect of the sun may be more marked.

Aluminum type lightning arresters for outdoor service are frequently painted a light color, a white aluminum paint being used, for the reason that the sun's rays may be reflected and the heat thus not absorbed to the same extent as were the case colored black. The reason that this is done in this case is, of course, because there is no heat to be radiated except while the arrester functions, while it is most advisable that the temperature of the electrolyte be kept down.

In one recent installation of three 5000-kw. single-phase water and oil-cooled outdoor transformers for stepping the voltage up to about 120,000 volts, the tops of the transformers were painted white, while the cases were painted black. In this way the direct rays of the sun in falling down upon the top of the transformers could be reflected without the color of the top affecting the radiation of heat from the transformer the case.

The thing operating engineers want to know is to what extent the temperature rise is effected by external color in absorbing heat or emitting it. Knowing this, it is then a matter of deciding which is the more important for any definite case, whether to radiate heat most efficiently or to reflect heat. For example, where a transformer carries a heavy load for a short period, as may be the case of a transformer supplying light, it may be found that the hot day's sun maintains the oil at such temperature as to seriously limit the safe evening load. On the other hand, by painting the transformer cover a light color, the no-load temperatures attained may be so much lower as to enable the evening load to be safely carried and yet not affect the temperature during the peak. Experience seems to show that a transformer in the sun, when painted white, will have about 5 per cent lower temperature rise than the same unit when painted black. The extent to which radiation is reduced, the writer does not know, but would appreciate the experience of other engineers.

## LARGE BRITISH BOILERS AND STOKERS.

What are stated to be the largest boilers in Europe are on order for the Charing Cross Electric Supply Company's Bow Station, says Engineering. The boilers are double-ended Richardson-Westarth boilers with 20,700 sq. ft. of heating surface and with an evaporation of 100,000 lbs. from and at 212 deg. hourly.

Each big boiler is to be served by a 24-retort Erith-Riley stoker, 12 retorts installed under each end of a boiler. About 6 tons of coal will be burned hourly. The unit, comprising boiler and stoker, occupy a floor space of 23 by 36 ft., or 828 sq. ft.

### Street Lighting Schedules for August.

Every plant operating street lighting circuits must have a definite schedule for lighting and extinguishing the lamps. Below are given the two most commonly used schedules as compiled for next month. The table is compiled for latitude 40° north. Since throughout August the daylight-saving plan of having all clocks set one hour ahead of standard time will be followed, the time given in the table (instead of being mean local or solar time, as is usually indicated in general street lighting schedules) has been advanced one hour in each case.

AUGUST, 1918.

| Night of | All-Night Schedule. | | Moonlight Schedule. | |
|---|---|---|---|---|
| August | Light. | Extinguish. | Light. | Extinguish. |
| 1 | 8:45 | 5:30 | 8:45 | 2:35 |
| 2 | 8:45 | 5:30 | 8:45 | 3:30 |
| 3 | 8:40 | 5:30 | 8:40 | 4:30 |
| 4 | 8:40 | 5:30 | 8:40 | 5:00 |
| 5 | 8:40 | 5:30 | 8:40 | 5:00 |
| 6 | 8:40 | 5.35 | 8:40 | 5:05 |
| 7 | 8:40 | 5:35 | 8:40 | 5:05 |
| 8 | 8:35 | 5:35 | 8:35 | 5:05 |
| 9 | 8:35 | 5:35 | 8:35 | 5:05 |
| 10 | 8:35 | 5:35 | 8:35 | 5:05 |
| 11 | 8:35 | 5:40 | 8:55 | 5:10 |
| 12 | 8:30 | 5:40 | 9:20 | 5:10 |
| 13 | 8:30 | 5:40 | 9:50 | 5:10 |
| 14 | 8:30 | 5:40 | 10:30 | 5:10 |
| 15 | 8:30 | 5:40 | 11:10 | 5:10 |
| 16 | 8:25 | 5:40 | 12:00 | 5:10 |
| 17 | 8:25 | 5:45 | 12:55 | 5:15 |
| 18 | 8:25 | 5:45 | 2:00 | 5:15 |
| 19 | 8:20 | 5:45 | 3:05 | 5:15 |
| 20 | 8:20 | 5:45 | No light | |
| 21 | 8:20 | 5:45 | No light | |
| 22 | 8:20 | 5:50 | No light | |
| 23 | 8:15 | 5:50 | 8:15 | 9:15 |
| 24 | 8:15 | 5:50 | 8:15 | 9:45 |
| 25 | 8:15 | 5:50 | 8:15 | 10:20 |
| 26 | 8:10 | 5:50 | 8:10 | 11:00 |
| 27 | 8:10 | 5:55 | 8:10 | 11:40 |
| 28 | 8:10 | 5:55 | 8:10 | 12:30 |
| 29 | 8:10 | 5:55 | 8:10 | 1:25 |
| 30 | 8:05 | 5:55 | 8:05 | 2:25 |
| 31 | 8:05 | 5:55 | 8:05 | 3:25 |

Tables for each month of the year, rules for the two schedules given above and for modifications of them, corrections for standard time and latitude, monthly and yearly total hours of burning for the five most common schedules, as well as other information pertinent to the subject, are printed in a booklet obtainable from the ELECTRICAL REVIEW for 25 cents a copy.

# Contracting-Construction

## *Interpreting the New Grounding Rules of the 1918 Code—Patented Yoke to Facilitate Telephone-Line Construction*

### RULES AS TO GROUNDING OF SERVICES AND CONDUIT SYSTEMS.

**Explanations of Grounding Rules Furnished by Mr. Day to the National Association of Electrical Inspectors.**

At the summer meeting of the Western New England Section of the National Association of Electrical Inspectors held at Hartford, Conn., June 26, Thomas Henry Day, past-president of the association, explained at some length the new regulations on grounding that are included in Rule 15A of the 1918 edition of the National Electrical Code. Although a considerable portion of this Rule 15A was formerly included

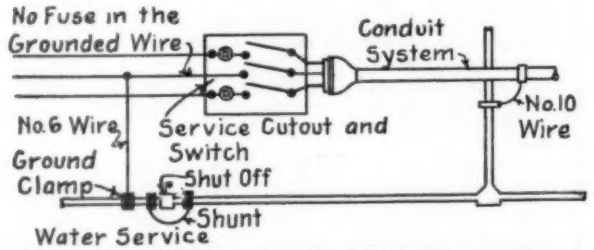



Fig. 1.—Method for Grounding the Service Wire and Interior Conduit System Where No Service Conduit Is Provided.

under the old rule No. 15, there is much new matter, some of which has been obtained from the National Electrical Safety Code issued by the Bureau of Standards, Washington, D. C.

However, inspectors are somewhat puzzled in the intepretation of some features of the grounding rules, and for this reason Mr. Day explained the rules with the aid of large diagrams. These have been condensed into the form of a blueprint, which has been sent to members of the association, and through the courtesy of the Western New England Section we are enabled to reproduce the diagrams herewith.

Fig. 1 shows the method of grounding the service wire and interior conduit system where no service conduit is provided. It shows a three-wire service with

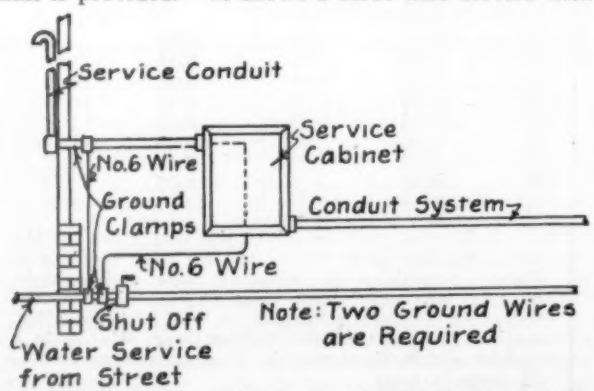



Fig. 2.—Method of Grounding a Combined Service and Interior Conduit System and the Service Wire.

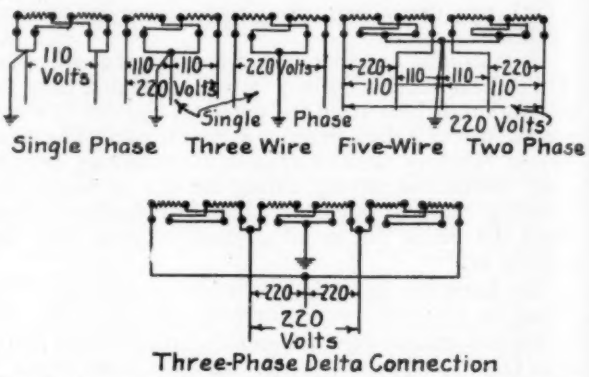



Fig. 3.—Location of Ground Connections on Alternating-Current Secondary Systems of Four Different Types.

the middle (neutral) wire grounded by means of an approved ground clamp connected to the water piping. The interior conduit system is also grounded to the adjoining piping system in this case by a smaller wire. In order to prevent the interior piping from having a different potential than the street water mains in case of possible disconnection of the inside piping system at the shut off or water meter, it is necessary to provide a shunt around this shut off or meter.

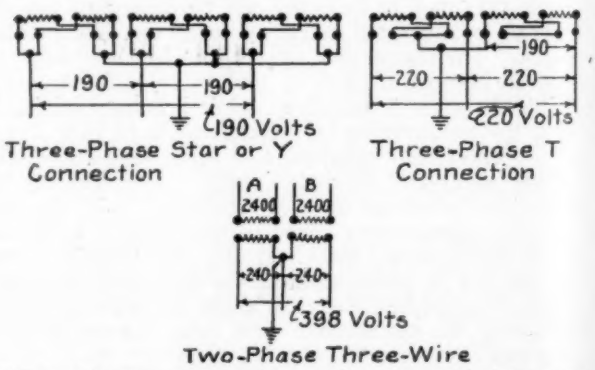



Fig. 4.—Location of Ground Connections on Alternating-Current Secondary Systems of Three Other Types.

Fig. 2 shows the method for grounding a conduit system where a service conduit is provided. In this case it will be noted that the service conduit is grounded and since a service cabinet is provided to which the interior conduit system is properly connected, the service conduit ground also acts as the ground for the interior conduit. However, it does not act as a ground for the neutral service wire, for which a separate ground is required. This is shown in the diagram in which both of these grounds are shown connected separately on the street side of the meter or shut off in the water piping system. Mr. Day explains this requirement in the following manner:

"As to the use of separate ground wires for service

conduit and service secondary, the two independent and separately attached to the water service, the reasons for the two are briefly as follows:

"With a single wire any break in the connection to the water pipe would place the conduit throughout the building at the voltage of the secondary neutral, which, if other grounds were missing in power, condition or of higher resistance, might mean a very considerable voltage above the water pipes throughout the building and therefore cause considerable fire and life hazard.

"On the other hand, if two ground wires are used the break of the conduit ground wire would simply mean a loss of protection requiring some other breakdown before any danger occurs. A break in the ground wire from the service wire would simply mean the loss of protection against high voltage on the secondary and would require a breakdown somewhere before this would become seriously higher than the ordinary low voltage of the circuit.

"In other words, the joining of the two wires is likely to create a dangerous condition throughout the building without any other circumstances intervening, and is therefore a danger of much higher order than either of the others noted."

Fig. 3 shows the location of grounds as required by section *g* of Rule 15A, as applied particularly to different connections of transformers. The first sketch shows an ordinary two-wire, 110-volt, single-phase system; then there are two sketches, one showing a three-wire single-phase system, and another a 220-volt, two-wire single-phase system; next a diagram showing a five-wire, two-phase, and finally, a three-phase delta connection.

Fig. 4 shows further connections for grounding transformer secondaries, in the first place where a three-phase star connection is used, in which case, of course, the neutral wire is grounded. The next shows a three-phase T connection, and the last sketch shows a two-phase, three-wire connection. It is believed that these diagrams will be of much value to inspectors, and also to contractors, in guiding them as to the proper location of the ground.

## YOKE TO FACILITATE TRANSPOSITION WHEN INSTALLING TELEPHONE LINES.

### Patented Device Saves Time and Labor.

In installing telephone-line wires on cross-arms, considerable delay is occasioned whenever the wires of one pair have to be transposed, as both wires have to be disconnected from the pulling device and again

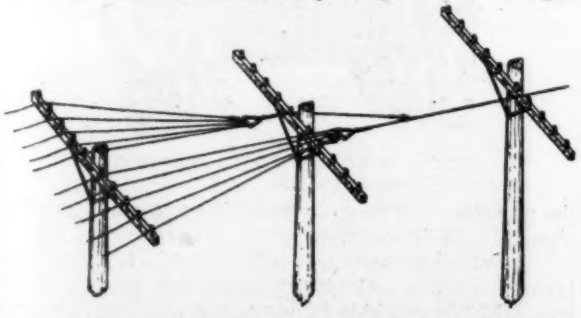


Fig. 1.—Pulling Wires for a Telephone Line by Means of Williams Yoke.

connected to the latter. Errors have also been due to the same cause. To avoid both of these difficulties, Harry C. Williams, of Irvington, N. J., has invented a pulling yoke with wire carriers swiveled to it so that the wires of each pair can be readily transposed, or one pair of wires can be transposed with respect to another pair, all without disconnecting them from the carrier or relaxing the tension. The method of using it is shown in Fig. 1.

For this purpose, the bar to which each pair of wires is connected by loops is swiveled on the bolt supporting it, but is ordinarily kept from rotating on the bolt by its engagement with the flattened part of the bolt shank shown in a part of Fig. 2. If the wires

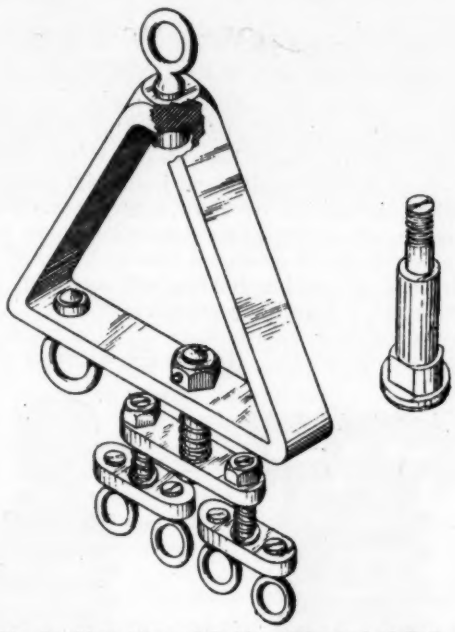


Fig. 2.—Close View of Pulling Yoke and of Bolt.

are to be transposed, the bar is raised sufficiently to clear this flattened part of the bolt, and can then be swung around so as to transpose the wires. The same can be done with the bar to which both of the bolts are connected, thereby transposing one pair of wires bodily with respect to another pair. The mechanism is covered by United States Patent No. 1,265,851, dated May 14, 1918, assigned to the American Telephone & Telegraph Company.

## AMONG THE CONTRACTORS.

In providing housing facilities for the big shipyard at Hog Island, Philadelphia, Pa., the Nicholson Electric Company of that city has under way the wiring of 414 workmen's dwellings. Each is provided with 11 outlets installed on the knob-and-tube wiring system. Exclusive of fixtures, the contract amounts to about $16,750 and will be completed in September.

The F. E. Newberry Electric Company, through its San Francisco office, has received the contract for all the electrical work in the new factory, warehouse and office of the American Can Company, at its Fruitvale, Oakland, Cal., works. A total of 66 motors, aggregating 288 horsepower, will be installed, also feeder and lighting systems for the entire works.

The George Weiderman Electric Company, Brooklyn, N. Y., is doing all the electrical work on a new hospital at Allentown, Pa., the contract amounting to about $14,000. All the wiring is in conduit and provides for about 650 outlets, a complete nurses' call system, intercommunicating and exchange telephone systems, fire alarm systems, electric clocks, and 9 motors aggregating 60 horsepower.

# New Appliances

## *Bus Insulators—Movie Compensarc—Small Turbo Units —Electric Coin Handler—New Contactor—Marine Switch*

### CEMENT POST INSULATING SUPPORTS FOR FLAT AND ROUND BUSES.

The Form "A" cement post insulating supports manufactured by the Electrical Engineers Equipment Company, Chicago, have been designed to meet average needs of central station and industrial plant. Each porcelain unit consists of a corrugated porcelain post, the number of corrugations depending upon voltage. A metallic thimble is cemented into each end of a post, to which the various bus-holding and mounting fittings are attached for forming a complete unit.

The porcelain units are made for 3500, 7500, 15,000 and 25,000-volt service. The design of these supports

Type MF and RF, Form "A," Cement Post Insulating Supports for Carrying Flat and Tubular Buses.

is most flexible; any of the bus-holding units can be attached to any of the porcelain units, and either pipe or flat mounting units can be used with any of the porcelains. In this way changes may be readily accomplished on the ground, and changes in bus sizes made simply. All supports may be adjusted in either vertical or horizontal plane by a simple arrangement of locknut, permitting a rapid lining up or adjustment for difficulties in construction work. All porcelain is made by the wet process, and subjected to standard tests. All porcelain is guaranteed to withstand side thrust of 900 pounds, and a tensile pull of 1800 pounds. The porcelain can be supplied in standard brown or royal blue glaze. There are eighteen standard arrangements of these supports, with all parts interchangeable. Some of these arrangements are shown in the accompanying illustrations.

Type AP and HP, Form "A," Cement Post Insulating Supports for Flat Vertical Buses.

### NEW COMPENSARC FOR MOTION-PICTURE PROJECTION.

To give the close regulation of current essential for Mazda motion-picture projection lamps, the General Electric Company has developed a new "Compensarc," designated as type I, form B. Protection is afforded against excess current and regulation to within 1/10 ampere is obtained. It operates on the reactance principle and is furnished for standard alternating-current voltages and frequencies in ratings of 20 and 30 amperes, corresponding to the Mazda lamps now on the market for this purpose. The Compensarc may be installed convenient to the operator, who can watch

New Reactance Type Compensarc.

the ammeter and control the current by the handwheel shown in the illustration.

This Compensarc is made up of a two-coil auto-transformer stacked with standard transformer punchings within a rawhide housing, the complete wiring of which forms the line side with the lamp terminals tapped across one coil. The coils are stacked so that room is left between them for an iron leakage plug in each side of the magnetic circuit. Turning a handwheel on the shaft of the iron plug moves it in and out between the two coils, thus giving a very close

adjustment for the lamp. Maximum reactance is obtained when the plug is all the way in. The only noise is a slight humming when the plugs are being withdrawn; this ceases when they come to rest.

The net weight is 32 pounds; over-all dimensions are 8-3/16 in. wide, 11-7/16 high and 10⅞ deep.

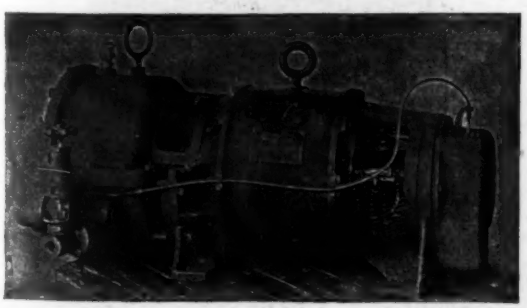
## SMALL WESTINGHOUSE TURBOGENERATOR UNITS.

To aid in furthering work in many lines, the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has recently produced a small turbogenerator unit for direct-current service. This unit is designed for 10 kilowatts output, although a temporary load of approximately 12.5 kilowatts may be obtained. A smaller unit of 8.5 kilowatts gives a range of capacity suitable not only for lighting work, but also for the majority of electromagnetic work.

Its range of capacity, its range of operating conditions and its construction make this an admirable unit for many uses. Among some of the fields of service for which it is adaptable are surface mining and other places where flood lighting for night work has come into such general use. Its range of operating conditions (80 to 235 pounds inlet steam pressure and from 0 to 10 pounds back pressure) makes this a suitable unit to install in oil refineries, where it can be used for furnishing sufficient light for the plant as a by-product in the oil refinery.

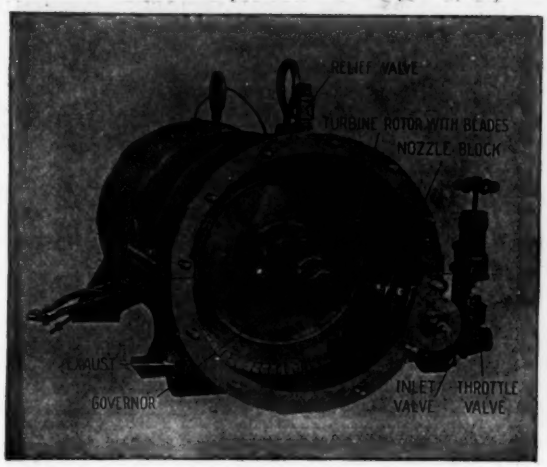
Since the energy developed is direct current, the new unit is finding great favor on steam locomotive cranes, where it is used for lifting magnets. Today locomotive cranes are in greater demand than ever before and, as many of these cranes are now equipped with electromagnets, this unit enables the user to have practically all the advantages of the electric locomotive crane in handling scrap and pig iron. Today, with the scarcity of labor, any labor-saving device in handling raw materials in yards and factories is of high importance in getting out larger production. The unit's simple, rugged and reliable construction enables it to be used at great distances from machine or repair shops, as there are no reciprocating parts to wear out, and as practically the only attention which it requires is to have its oil-well filled occasionally.

In building this 10-kilowatt set the manufacturer has recognized that it must operate under the most trying conditions. For that reason it is as simply constructed as possible, while yet having many of the features found desirable in larger units. Among these is a hand and automatic throttle valve and an emergency



Westinghouse 10-Kilowatt Steam Turbogenerator Set Complete.

overspeed governor. This latter feature is placed on the generator end of the unit and automatically closes the throttle valve of the turbine if the unit should show




Turbogenerator Set with Turbine Cover Removed.

a disposition to overspeed. The device consists of a small weight placed on the shaft of the unit which, at a predetermined speed, engages a trip lever connected in such a way to the throttle valve that it is automatically closed, thus stopping the unit.

The most important feature of this unit is that it has but one revolving element which has the generator shaft extended so that it also carries the turbine rotor. This not only makes a very compact machine, but eliminates all coupling and misalinement troubles and also dispenses with turbine bearings and packing.

The turbine rotor is made of a high-grade open-hearth steel forging accurately finished, in the periphery of which are placed blades of electric-furnace steel which are held in place by pins tightly driven in through blade and rotor. The blades are of the impulse type, and, although there is only one row of blades, yet by means of a reversing chamber the same steam is passed through the blades a second time, thus allowing complete expansion of the steam.

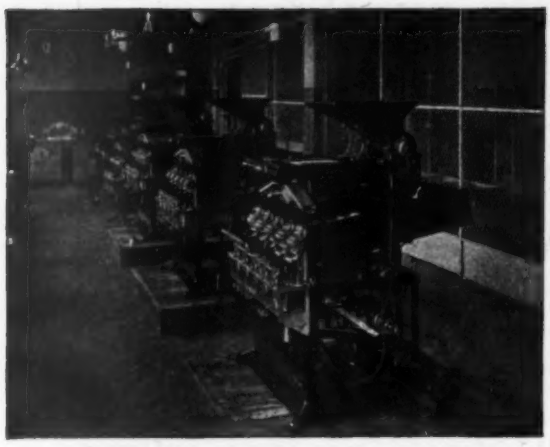
Since the unit is designed to occupy the least possible space, the manufacturer has equipped the generator with ball bearings; this, together with the fact that no bearings are required on the turbine, results in saving in bearing friction and a decrease in length and weight of the unit. Moreover, these self-alining ball bearings on small units are specially suited for a variety of services, particularly for marine work, which often compels the unit to operate at an angle due to the position of the ship.

As is shown in the first illustration, all open places on the unit have been covered with pieces of expanded metal which protects not only the operation but also the generator parts from entrance of foreign matter. Its compactness (the unit is only 3 feet 8½ inches long, 23 inches wide and 18¾ inches high), together with its lightness, permits the outfit to be used where space is valuable or for portable work.

## ELECTRICALLY-DRIVEN COIN-HANDLING MACHINE.

Much labor is saved daily at the offices of the Detroit United Railways by automatic coin-handling machines. A bank of machines made by the Sattley Coin Handling Machine Company, Detroit, Mich., handles an average of 200,000 coins each day.

The machines, operated by Westinghouse ⅓-horsepower motors, receive in the hoppers at the top the miscellaneous coins deposited from the fare boxes on



Bank of Automatic Coin-Handling Machines in a Street-Railway Company's Office.

the cars. Without further attention, battered and badly worn pieces are thrown out and the remaining coins are sorted into their respective denominations. These are accurately counted and properly wrapped in rolls of any desired amounts. Thus a great deal of time is saved and the element of error is reduced to a minimum.

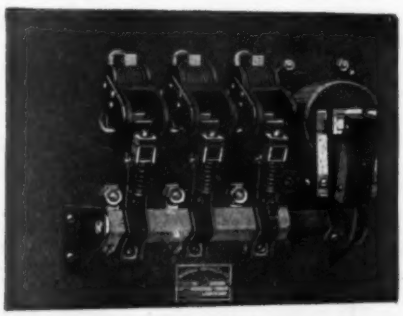
## ALTERNATING-CURRENT MAGNETIC CONTACTOR.

A new alternating-current magnetic contactor has been placed on the market by the Industrial Controller Company, Milwaukee, Wis. The contactor is designed for power and light circuits and may be furnished with either two or three poles, the switch being mounted on a square shaft at one side of the closing magnet and the shaft being held by a bearing at either end.

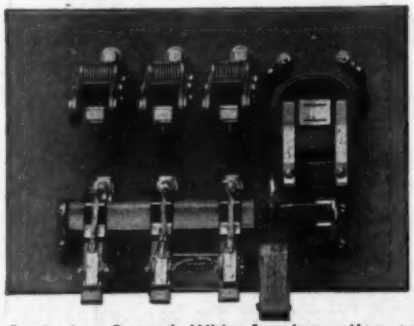
This contact is so designed that by the removal of a small U-shaped clamp the magnet armature may be slid along the shaft, and the contactor widely opened, permitting very free access for removal of the coil, contacts, etc., in case of repairs or replacements being necessary.

The magnet armature is arranged so that it automatically properly seats against the pole piece of the magnet, which arrangement practically eliminates all humming and vibration in the contactor and requires no bearing adjustment when assembling.

The contactors are manufactured in 30, 75 and 150-ampere capacities.



Alternating-Current Magnetic Contactor, Closed.



Magnetic Contactor Opened Wide for Inspection or Repairs.

## "DIAMOND H" MARINE SWITCH.

The Hart Manufacturing Company, Hartford, Conn., has placed upon the market a new "Diamond H" water-tight marine switch, external and internal views of which are shown in Figs. 1 and 2. These

Fig. 1.—Exterior View of "Diamond H" Water-Tight Marine Switch.

marine switches are made in two sizes, 15 and 30 amperes, respectively, and are designed and produced according to all approved naval specifications. The switches are mounted on heavy composite bases, with easy-wire binding post to facilitate wiring the switch on the top of the box without removing the switch itself. The boxes are made of heavy cast brass or cast iron, according to the requirements of the purchaser. The handle is permanently fastened to the cover in such way that the handle and cover are removed at once, in this way preventing any displace-

Fig. 2.—Interior View of "Diamond H" Water-Tight Marine Switch.

ment of the stuffing-box arrangement. The switches have been made in every way to uphold the standard of quality maintained in the manufacture of "Diamond H" switches.

# Current News

## Weekly Record of Construction Activities—Conventions

### EASTERN STATES.

NEWMARKET, N. H.—Newmarket Manufacturing Company has commenced the construction of a new one-story addition to its power plant, about 44x44 feet. The J. W. Bishop Company, 109 Foster street, Worcester, Mass., is the contractor.

AMHERST, MASS.—The Massachusetts Agricultural College has recently completed plans for the construction of a new turbine house at the institution.

CHATHAM, MASS.—The United States Government, Bureau of Yards & Docks, has had plans prepared for the installation of a new underground conduit system at Chatham.

FAIRHAVEN, MASS.—New Bedford Gas & Edison Light Company, 693 Purchase street, is having plans prepared for the construction of a new one-story brick transformer house at its plant, about 20x40 feet in size.

PITTSFIELD, MASS.—J. & E. H. Wilson, Wahconah street, have awarded a contract to D. Herbert Pike, 28 Renne street, Pittsfield, for the construction of a new one-story turbine plant at their works, about 25x30 feet.

BROOKLYN, N. Y.—The State Hospital Commission, Capitol building, Albany, has taken bids for the installation of new underground conduit system at the State Hospital, Brooklyn. E. S. Elwood is secretary.

BUFFALO, N. Y.—The Buffalo General Electric Company has filed notice with the Public Service Commission, second district, of proposed increase in electric light and power rates at Kenmore. It is said that the municipality will contest the advance.

NEW YORK, N. Y.—DeForest Radio Telephone & Telegraph Company, 1391 Sedgwick avenue, has acquired property on Commerce avenue, near One Hundred and Seventy-first street, adjoining its plant on Sedgwick avenue, to provide for extensions.

NEW YORK, N. Y.—Western Union Telegraph Company is said to be negotiating for the purchase of the New York Law School building located at 174 Fulton street, to be used, it is understood, for extensions.

NEW YORK, N. Y.—DeForest Radio Telephone & Telegraph Company has purchased a site at Seventeenth and Sedgwick streets for enlarging its wireless plant.

ROCHESTER, N. Y.—The Board of Managers of the Municipal Hospital is having preliminary plans prepared for the construction of a new boiler plant at the institution on Waring Road.

SYRACUSE, N. Y.—The Common Council is planning for the early construction of a new pumping station in Fellows avenue near Dakota street. It is understood that the works will be electrically-operated.

TOTTENVILLE. S. I., N. Y.—Staten Island Rapid Transit Railway Company has made application to the Public Service Commission for permission to issue bonds to the amount of $1,500,000, to be used, in part, for extensions.

UTICA, N. Y.—Utica Steam & Mohawk Valley Cotton Mills, 801 State street, has commenced the construction of a new one-story addition to its engine plant, about 25x45 feet. The structure will cost $15,000. Hopp & Down, 1022 Seymour avenue, Utica, are the contractors.

TAYLOR, N. Y.—R. L. Brown has purchased the mill and water rights owned by George M. Law. Additional electric equipment will be purchased and Cincinnatus and Taylor will be supplied with electric light and power.

ATLANTIC CITY, N. J.—The Board of Education is planning for immediate work on improvements and alterations in the heating plant in the West Side public school at Lincoln and Ohio avenues. H. H. Young, secretary of the board.

BERNARDSVILLE, N. J.—New Jersey Power & Light Company has completed three extensions and connections to the estates of R. H. Whitney, Leonard Jacobs and Morgan Cowperthwaite for light and power purposes. These extensions were paid for by the consumers, and the revenue from the current delivered over them will be approximately $800 per year.

CAMDEN, N. J.—The Emergency Fleet Corporation has commenced the construction of a new traction system to provide transportation facilities for workers engaged at the plant of the New Yok Shipbuilding Corporation, Broadway and Morgan street.

DOVER, N. J.—Work has recently been completed and operation inaugurated in a new spraying system at the plant of the New Jersey Power & Light Company.

EWING, N. J.—Until August 3, bids will be received by the Township Committee for furnishing service for the operation of the electric street-lighting system for a period of five years, effective September 1, 1918. A. M. Lanning, Township Clerk.

GLEN RIDGE, N. J.—The works of the Edison Storage Battery Company, extending from Bloomfield avenue to Belleville avenue, are to be sold. The plant covers an area about 168x540 feet, and includes power plant for operation.

HACKETTSTOWN, N. J. — The Common Council has contracted with the Hackettstown Electic Light Company for the furnishing of electric service for the operation of the street-lighting system for a period of one year, effective July 1, 1918, at $3500.

HAMILTON, N. J.—Township Committee has approved an appropriation of $10,000 to be used for lighting purposes for a period of one year.

JERSEY CITY, N. J.—The Board of Freeholders has arranged an appropriation of $10,000 for the use of the Boulevard Commission in improving the lighting system on the boulevard between Bergen Point and Paterson Plank Road.

NEWARK, N. J.—Public Service Railway Company has been granted permission to extend its traction lines on the west side of the Hackensack River for the accommodation of employes and others at the works of the Federal Shipbuilding Company.

NEWARK, N. J.—The Board of Education has taken bids for improvements and alterations in the boiler plant at the Lawrence street school building.

NEWARK, N. J.—Star Fan & Motor Works, 245 New Jersey avenue, has awarded a contract for the erection of a new one-story brick plant, about 90x130 feet, and 110x130 feet, at Miller and King streets, to provide for increased capacity. The work will cost about $31,000. The Newark Construction & Investment Company, 800 Broad street, Newark, is the contractor.

NEWARK, N. J.—Maas & Waldenstein Company, 437 Riverside avenue, has awarded a contract for the erection of the proposed new boiler plant addition to its works to cost $66,000. Henry M. Doremus & Son, 36 Orange street, Newark, is the contractor.

NEW BRUNSWICK, N. J.—The Jersey Central Traction Company has been requested by the Board of Freeholders to install new electric lights on the approach to the Raritan river drawbridge.

ROCKAWAY, N. J.—Empire Steel & Iron Company is arranging for improvements at its power plant to provide for uninterrupted service. The electric turbine furnishing power for operations at the company's mines at Mt. Hope has been out of commission due to breakage.

ROCKAWAY, N. J.—The New York Telephone Company is plannning for the immediate construction of a new telephone line from Mt. Hope to Lake Denmark. Permission for the work has been granted the company by the Township Committee.

TRENTON, N. J.—William Potter, Pennsylvania Fuel Administrator, is conferring with Government officials relative to the proposed appropriation of several millions to be made by Congress for the erection of a series of electric power stations in New Jersey and Pennsylvania.

TRENTON, N. J.—The City Commission has passed an ordinance providing for extensive improvements at

the municipal pumping station, including the erection of a new addition and the installation of pumping apparatus, the entire work being estimated to cost $150,000. It is understood that the station will be electrically-operated.

VENTNOR, N. J.—The City Council has made an appropriation of approximately $10,000 to be used for lighting purposes for the coming year.

ALLENTOWN, PA. — The City Council has recently completed the installation of new boilers at the municipal water works and inaugurated operations.

ALTOONA, PA.—Notice has been filed with the Public Service Commission by the Penn Central Light & Power Company of the issuance of bonds for $29,000, to provide for betterments, extensions, etc.

EASTON, PA.—Pennsylvania Utilities Company has filed notice with the Public Service Commission of a bond issue for $143,000, to provide for extensions, improvements, etc.

HARRISBURG, PA. — American Telegraph & Telephone Company has had plans prepared for the installation of a new underground conduit system in Walnut and Third streets, to replace the present overhead wires.

HAZLETON, PA.—Pardee Brothers & Company are considering plans for the immediate installation of electrical equipment for the operation of its Hollywood colliery.

MARYSVILLE, PA.—Juniata Public Service Company is making improvements in its system in the Marysville district.

PHILADELPHIA, PA.—Contract has been awarded by the Bellevue Worsted Mills, Wister street, for the erection of the proposed new one-story power plant at Sixteenth and Hunting Park avenue, about 30x90 feet. The structure is estimated to cost $18,000. H. E. Baton, 1813 Sansom street, Philadelphia, is the contractor.

PHILADELPHIA, PA.—Fire, on July 15, destroyed a portion of the power building at the works of the William & Harvey Rowland Company, Inc., Lewis and Taconey streets, in the Frankford section, with total loss estimated at approximately $75,000.

PHILADELPHIA, PA.—Philadelphia Rapid Transit Company and Philadelphia Railways Company have placed in operation two new traction lines extending to the Hog Island shipyards commencing at Fortieth and Market streets, and Third and Jackson streets.

PHILADELPHIA, PA.—The complete establishment of the "lightless night" order throughout the city has been delayed by the fuel administration, but it is announced that the order will be made effective within a week or ten days. In the meantime the power saving regulation as regards elevators in office buildings has been operative and cars are now being run only between the hours of 7:30 a. m. and 6:30 p. m. Notwithstanding the fact that the leading hotels are exempt from the electric light and power saving regulation, they are co-operating in the work; the Bellevue-Stratford and other hotels have reduced the light consumption about 33 and one-third per cent and the elevator service about 25 per cent.

## DATES AHEAD.

Association of Iron and Steel Electrical Engineers. Annual convention, Southern Hotel, Baltimore, Md., September 9-14. Secretary, John F. Kelly, McKeesport, Pa.

Northwest Electric Light and Power Association; affiliated with N. E. L. A. Annual convention, September 11, 1918. Secretary, George L. Myers, Pacific Power & Light Company, Portland, Ore.

International Association of Municipal Electricians. Annual convention, Atlanta, Ga., September 24-27. Secretary, Clarence R. George, Houston, Tex.

New England Section of the National Electric Light Association. Annual meeting, Hotel Kimball, Springfield, Mass., September 27 and 28. Secretary, Miss O. A. Bursiel, Boston, Mass.

American Electrochemical Society. Fall meeting, Princeton, N. J., September 29 to October 1. Secretary, Prof. J. W. Richards, Lehigh University, Bethlehem, Pa.

American Electric Railway Association. Annual meeting, Atlantic City, N. J., October 8 and 9. Secretary, E. B. Burritt, 8 West 40th street, New York City.

Kansas Public Service Association. Annual meeting, Kansas City, Kans., October 17-19. Secretary-treasurer, W. W. Austin, Cottonwood Falls, Kans.

PITTSBURGH, PA.—Standard Underground Cable Company has had plans prepared for the erection of a new one-story brick addition on Pike street, near Sixteenth street, to cost $7,000.

PITTSBURGH, PA.—Crescent Electric & Manufacturing Company has recently completed the establishment of a large new plant at 2515 Penn avenue to be used for electrical repair work.

READING, PA.—Metropolitan Edison Company has commenced the assembling of the new 25,000-kilowatt turbogenerator to be installed in its West Reading power station. The company has recently completed the installation of two new 1,000-horsepower boilers and operations will be inaugurated at an early date.

READING, PA.—Metropolitan Edison Company has filed notice with the Public Service Commission of the issuance of bonds aggregating $142,500.

WASHINGTON, D. C.—Contract has been awarded by the Corby Company, Langdon station, near Washington, for the construction of a new boiler plant at its works. F. L. Wagner, 1413 H. street, N. W., Washington, is the contractor.

WASHINGTON, D. C. — United States Government, Bureau of Yards & Docks, has awarded a contract for the construction of a new local power plant. The structure will cost about $44,000. Gillis & Geoghegan, 537 West Broadway, New York, are the contractors.

## NORTH CENTRAL STATES.

ARCANUM, OHIO.—$3,000 in bonds will be sold for improving the electric light system. Address C. C. Taylor, village clerk.

PERU, IND.—$15,000 in bonds will be offered for sale for electric light plant. Homer L. Baltimore, city clerk.

WINCHESTER, IND.—Eastern Indiana Telephone Company has been authorized to begin business with capital stock of $40,000. The company will build and operate telephone lines and exchanges. The directors are P. E. Goodrich, J. A. Browne, R. J. Litschert, P. S. Hunt and James S. Engle.

CHAMPAIGN, ILL.—Central Union Telephone Company has filed a petition with the Illinois Public Utilities Commission asking for the approval of the purchase of the Home Telephone Company of Champaign.

EAST PEORIA, ILL.—The village board has signed a new lighting contract with the Central Illinois Light Company. It provides that arc lights shall cost $55; 600-watt incandescents and 300 and 400-watt incandescents at $25 instead of $20, the former price.

NAUVOO, ILL.—A company has been organized to build a transmission line from Dallas City to LaHarpe, a distance of 21 miles. The transmission lines will be built to Stronghurst, Raritan, Good Hope, and other small towns. Address J. M. Fisher, Nauvoo.

SPRINGFIELD, ILL. — Springfield Terminal Railway Company has filed a petition with the Illinois Public Utilities Commission for the right to issue notes for $68,645.

EATON RAPIDS, MICH. — The work of installing a pedestal lighting system has been commenced, and it is proposed to have the system in operation by the latter part of July.

RACINE, WIS.—Prefex Radiator Company will receive bids August 1 for enlarging its factory. Electric equipment will be purchased.

MAHNOMEN, MINN.—H. S. Picher will enlarge electric light plant.

VIRGINIA, MINN.—Bonds have been voted for improving the municipal light and water plant. Address city clerk.

EARLY, IOWA.—The Early electric light plant was damaged by fire recently.

IOWA CITY, IOWA.—Postal Telegraph Company will install new electrical equipment in the Post Office building at Dubuque street. Address H. E. King, construction superintendent.

MUSCATINE, IOWA.—Muscatine Lighting Company will construct a transmission line to supply energy to the Farmers Electric Light Company.

HOLDEN, MO.—Preliminary plans are in progress to rebuild the electric light plant recently destroyed by fire. Archer & Stevens, 609 New England building, Kansas City, Mo., engineers. Mr. Bausaw, Mayor.

## SOUTH CENTRAL STATES.

LYLES, TENN.—In connection with the proposed new wood chemical manufacturing plant to be erected by the Bon Air Coal & Iron Corporation of Nashville, to cost in the neighborhood of $1,000,000, a large new power house for works operation will be constructed. Contract has been awarded to the George A. Fuller Company, New York.

SARDIS, MISS.—Panola Electric Light & Power Company will rebuild plant which was burned recently.

HUTTIG, ARK. — Fire recently destroyed the power plant and a portion of the planing mill of the Union Sawmill Company, with a total loss estimated at approximately $40,000.

MARIANNA, ARK.—The city council of Marianna has instructed its light

committee to get prices on the boilers and other equipment necessary to install an independent power plant for use in operating the water system of the city. The city already owns a good deal of equipment and it is believed that with the installation of additional machinery, adequate water service can be assured. The water is now pumped by the Arkansas Light & Power Company and the arrangement has caused much complaint.

GUEYDAN, LA.—Bids will be received on August 12 for the purchase of $15,000 electric light bonds. Address M. I. Ramsey, Mayor.

DUNCAN, OKLA.—An election will be called soon to vote bonds for sewerage disposal plant, waterworks extensions and addition to power plant. Benham Engineering Company, 1300 Colcord Building, Oklahoma City, Okla., engineers.

PONCA CITY, OKLA.—An election was held recently to vote $40,000 bonds for electric lights and $35,000 for waterworks extension.

YALE, OKLA.—Extensive improvements will be made to the electric light system. G. H. Reff, city clerk.

ORANGE, TEX.—The Chamber of Commerce is promoting plans to extend the lighting system.

SEGUIN, TEX.—Guadalupe Power Company will develop power on the Guadalupe river. Parsons & Simpson, engineers, 7 Pine street, New York, have prepared plans for several small plants. Address W. B. Dunlap, president of the company, Beaumont, Tex.

WASHINGTON, D. C.—The Bureau of Yards & Docks, United States Government, has awarded a contract to John Griffiths & Son Company, Chicago, for the installation of a new electric system at the marine barracks at Paris Island, S. C.

NORFOLK, VA.—Chesapeake & Potomac Telephone Company, Thirteenth and G streets, Washington, D. C., is making rapid progress in the construction of a new two-story addition to its telephone building on Twenty-eighth street. The structure will cost $15,000. Framnis Brothers & Heigley, 18 Clay street, Baltimore, Md., are the contractors.

GREENSBORO, GA.—The city is considering plans for improvements in the municipal lighting plant and water works.

AUGUSTA, GA.—In connection with improvements at the municipal electric plant, the city has awarded a contract for the installation of new transformers.

## WESTERN STATES.

PUEBLO, COLO.—Two new alfalfa mills are being constructed in the Arkansas Valley district, which is served electrically by the Arkansas Valley Railway Light & Power Company, of Pueblo. Both of these mills are located between Ordway and Crowley and will be equipped with the latest machinery operated electrically throughout. A transmission line to serve these mills will also provide power for several ranchers en route.

CASCADE, WASH.—J. B. Hill has filed an application for the construction of a 75-horsepower plant at Cascade. The power is to be generated by the Payette river.

BELLINGHAM, WASH.—A blanket deed to all its properties and water rights on Skagit river in Washington has been placed on record, same being transferred to the Western Washington Water Power Company, the value indicated being $208,000. The Western Washington Water Power Company then transferred the same by deed to the Puget Sound Traction Light & Power Company with an indicated value of $677,000. The third paper to be placed on file was a renewal of a $20,000,000 mortgage by the Puget Sound Traction Light & Power Company to the Old Colony Trust Company of Boston.

HOQUIAM, WASH.—Lamb Machine Company is to erect a $50,000 steel plant in connection with its machine shop. An electric furnace with a capacity of two tons per heat and from 3 to 6 heats per day will be installed. Some 550 horsepower of electric current will be required. The plant is to have a capacity of 10 tons of steel and from 5 to 6 tons of iron castings per day.

SEATTLE, WASH.—Todd Dry Dock Company, 1801 16th avenue, Southwest, is to construct a two-story heavy timbered power house and storehouse building at the local plant of the company to cover 100 by 50 feet and cost $9000.

SPOKANE, WASH.—Contracts for heating buildings in the downtown district, held by the Spokane Service Company, a subsidiary organization of the Washington Water Power Company, and most of which expired July 1, will not be renewed under notice given to contract holders by the company. Other contracts will be cancelled as quickly as possible. The heating business has not proven profitable to the company and the company is not interested in continuing it.

## INCORPORATIONS

WINCHESTER, IND.—Eastern Indiana Telephone Company has incorporated to operate telephone lines and exchanges with a capital of $400,000. P. E. Goodrich and J. A. Brown are the incorporators.

SEDAN, KANS.—Sedan Electric Light & Power Company, chartered with $16,000 capital stock by R. M. Hartzell, Mary W. Hartzell and M. W. Hartzell, all of Sedan.

AU SABLE FORKS, N. Y.—Au Sable Forks Electric Company. Capital, $25,000. To operate a local electric system. Incorporators: J. Rogers, G. Chahoon and J. M. Sheffield, Au Sable Forks.

BROOKLYN, N. Y.—Allied Electrical Company. Nominal capital, $5,000. To operate a local electrical contracting establishment. Incorporators: B. Friedman, L. Weiss and J. G. Feldman, 357 Third Street.

NEW YORK, N. Y.—Carver & Nate Company. Capital, $10,000. To manufacture hydraulic equipment and heating and ventilating apparatus. Incorporators: C. D. Landry, F. H. Carver and E. F. Whittier, 533 Macon Street, Brooklyn.

## NEW PUBLICATIONS

EFFECT OF THE SIZE OF GROG IN FIRE-CLAY BODIES.—The Bureau of Standards, Department of Commerce, has issued a new publication entitled "Effect of the Size of Grog in Fire-Clay Bodies," Technologic paper No. 104. The size of grain has long been known to exert considerable influence upon the properties of mortars, concrete, fire clay refractories, and other materials. The present investigation determines the effect of the size of the calcined portion, or grog, upon the properties of fire clay bodies within a field of practical sizes. The general plan of procedure consisted of separating grog into a number of sizes, recombining these in arbitrary proportions by calculation from triaxial diagrams, mixing with an equal weight of clay, and molding with water into test pieces for raw state, as indicated by the modulus of rupture, depended upon a number of factors and did not vary directly with the size of grog. Proper proportioning of grog sizes gave stronger bodies than single grog sizes. The strength of burned bodies increased directly with decrease of the size of grog. Bodies containing the larger sizes were more resistant to sudden heating and cooling from 600° C. and 1000° C. Volume shrinkage in burning to cone 12 increased approximately with decrease of porosity in the dry or burned states. Methods are suggested for proper proportioning of grog for glass pots, saggers, and similar bodies.

"THE ELECTRICIAN ANNUAL TABLES OF BRITISH AND FOREIGN ELECTRICITY UNDERTAKINGS, 1918," is the title of a directory issued by the "Electrician," London. This directory is divided into ten parts, dealing respectively with British electricity supply undertakings, electricity supply schemes projected, provisional orders undeveloped, British electric power companies, colonial electricity supply works, Russian electricity supply works, foreign electricty supply works, colonial tramways and railways, foreign electric railways and tramways, Argentine electricity works, and comprises 100 pages, 9x12½ inches. Considerable advertising matter is intermixed with the reading pages.

This is the second year "The Electrician" has published these annual tables. Despite the very great difficulties imposed by the war the whole of the contents of the present issue have been revised and brought up to date. In the case of the British sections, the information is in most instances as of April 30 of this year. The director gives useful information to all interested in the world's electricity supply undertakings, and will prove of value to those seeking wider markets for their products, or seeking to find out what apparatus is suited to electricity supply in some far off country. A study of light and power rates, apparatus in stations, and methods of transmission and distribution offers much useful data of an authoritative nature. Copies of the directory may be obtained from "The Electrician," 8, Bouverie Street, London, for $1.25 (5/—).

# Trade Activities

## Collyer Insulated Wire Company Reorganized—Steel & Tube Company Personnel—Valuable Catalogs Distributed

**Harvey-Taeubert Manufacturing Company,** 1333 South Los Angeles street, Los Angeles, Cal., was recently organized to engage in the manufacture of electrical specialties. Leo M. Harvey and E. E. Taeubert are officials of the company.

**Harvey Hubbell, Inc.,** Bridgeport, Conn., has just issued loose-leaf bulletin No. 16-5 for insertion in Catalog No. 16 published by the company. This bulletin briefly illustrates and describes Hubbell weatherproof sockets, including porcelain weatherproof, moulded mica weatherproof and composition weatherproof types.

**Anderson Electric Specialty Company** has moved into its new factory at 118-124 South Clinton street, Chicago, Ill. The increased space will treble its capacity in order to take care of the very heavy demands for the "Autoreelite" automobile accessories and the "Adapt-a-Lite" lighting specialties. The Anderson company has also added a new department for the manufacture of dental and laboratory appliances.

**Collyer Insulated Wire Company,** Pawtucket, R. I., recently underwent a complete reorganization. The active management of the company has been placed in the hands of two prominent wire authorities, R. C. Moeller having been appointed manager and treasurer, and D. S. Davis, assistant manager and assistant treasurer. Both of these men were formerly connected with the American Steel & Wire Company, and the experience they received while with the latter company eminently qualifies them to manage the affairs of the Collyer company. H. M. Fitz is president of the company.

**Steel City Electric Company,** Pittsburgh, Pa., has issued its catalog No. 33. This consists of matter that has previously been published by the company in the form of separate bulletins, thus bringing together into a 108-page book all of this information for convenient reference. A large number of fine illustrations are shown of the various fittings made by the company, also a few views of buildings in which these fittings are used extensively. The company will continue to publish for use in a loose-leaf binder separate discount sheets on the various classes of material. A valuable feature of the book is the comprehensive index and cross index of the various products, catalog numbers, code words, etc. Among the principal products listed are Fullman bushings, locknuts, fixture stems, hangers, conduit benders, marine fixtures, Steel City switch boxes, outlet boxes and covers, fittings for Ovalduct conduit, Campbell attachment plugs and receptacles, Fullman floor outlets and a large variety of Universal insulator supports, clamps for cables, beam strips, etc.

**Western Electric Company, Inc.,** has under construction at its Hawthorne Works, in Chicago, four new buildings of steel and reinforced concrete, five and six stories high, for factory and warehouse purposes, which are costing close to $1,000,000. They occupy 675 by 211 feet of ground close to Cicero avenue and Twenty-second street.

**Industrial Electric Furnace Company,** Chicago, has received an order for two electric furnaces from the Western Steel Car & Foundry Company, Hegewisch, Ill. The furnaces will each have a capacity of one and one-half tons of steel, and will be designed for acid operation on steel castings. Each furnace will operate single-phase, off a three-phase supply.

**Hotpoint Division of the Edison Electric Appliance Company, Inc.,** Chicago, has issued a new price list of Hotpoint appliances, effective July 15. The increase in the prices of these appliances has been necessitated by the increased cost of raw material, cost of production and transportation, and general operating expenses. The list also includes recent additions to the Hotpoint lines, comprising air heaters, hollow-ware accessories, auto heater, curling irons, luminous heaters, etc.

**Beardslee Chandelier Manufacturing Company,** 216 South Jefferson street, Chicago, has issued a folder entitled "Day Brightness." It sets forth very effectively the value of better lighting for obtaining better results, this being accomplished by the use of the Beardslee Denzar units in the store, factory and office. Three types of Denzar units are shown and data respecting them given. This type of unit entirely encloses the lamp in a dustproof glass housing, the upper portion of which is a dome-shape reflector. The unit is a very pleasing one as to appearance and is meeting with considerable favor in a large number of offices, stores and also the more exacting departments of factories.

**Steel & Tube Company of America,** which has taken over the properties of the Iroquois Iron Company and Mark Manufacturing Company, announces the following officers: Clayton Mark, chairman of board of directors; Ferdinand Schlesinger, chairman executive committee; A. A. Schlesinger, president and treasurer; and C. P. Wheeler, C. T. Boynton, Anson Mark, Clarence Mark, vice presidents. The new concern is capitalized at $92,000,000, and is allied to the interests of the Semet-Solvay Company, Newport Mining Company, Elkhorn Piney Coal Mining Company; Pickands, Mather & Company; Pickands, Brown & Company; Iroquois Iron Company, Mark Manufacturing Company, By-Products Coke Corporation, and the Schlesinger interests.

**Pacific States Electric Company,** was recently appointed the exclusive sales agent on the Pacific Coast for the Fibre Conduit Company, manufacturer of Orangeburg fibre conduit, Orangeburg, N. Y. The Pacific States Electric Company will carry ample stocks of this company's line at the six houses to serve the electrical men of the West.

**Leeds & Northrup Company,** Philadelphia, Pa., has just published a 60-page catalog entitled "The Potentiometer System of Pyrometry and Temperature Control," which describes a system of pyrometry and temperature control in which the potentiometer method is employed for measuring the electromotive force of thermocouples. A known electromotive force is included in the circuit with the thermocouple and by varying the known electromotive force the current can be varied until a galvanometer, also in the circuit, indicates that no current is flowing. Due to the fact that no current flows at the moment of measurement, changes in the resistances of lead wires, thermocouples, galvanometers, etc., are eliminated and do not affect the result. By making the lead wires of the same material as the thermocouple, the "cold junction" of the latter is brought back to the instrument where its effects can be compensated for automatically. The variable electromotive force is obtained by a moving contact along a slide wire through which a standardized current is flowing. This may be done by hand, as in potentiometer indicators, or by mechanical power as in the Leeds & Northrup recording potentiometers.

In these instruments the galvanometer acts merely as a trigger or pilot. When deflected, the boom is forced by reciprocating parts against other parts which mechanically adjust the slide wire contact, the amount of adjustment depending upon the amount of deflection. When no current is flowing the boom stands at the neutral position and there is no adjustment. It is thus possible for a delicate and sensitive galvanometer to control the expenditure of a considerable amount of power. This fact has been taken advantage of to construct curve-drawing and multiple-circuit printing recorders, and also to operate signal lamps and indicators at the furnaces. The recorder thus takes the place of an attendant, who would otherwise be required to read the pyrometer and to signal its indications. The potentiometer is also applied to a special apparatus for the location of the thermal transformation or recalescence and decalescence points of metals. The Leeds & Northrup Company has developed an apparatus by which temperatures are plotted as ordinates and temperature differences between the sample and a non-recalescing body on a magnified scale as abscissae. Copies of this book will be furnished on request.

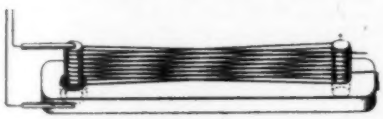
# Recent Patents

## Selected and Summarized by Albert Scheible, Patent Attorney, 79 West Monroe Street, Chicago, Illinois

*A series of brief comments on some of the recently issued electrical patents which appear to be of particular interest to our readers, the number after each heading being that of the United States patent to which the summary relates. Any correspondence regarding such patent matters should be sent direct to Mr. Scheible at the above address.*

**Revolving Sign (1,268,375).**—To utilize water tanks more effectively for advertising purposes, Frederick William Meyer, of Jersey City, N. J., mounts sign letters on a rotatable frame surrounding the tank, and carries the current to this by contacts, so that the sign will be continuously lighted while traveling around the tank.

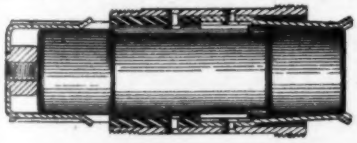
**Shaping Tungsten Filaments (1,265,575).**—To prepare filaments for the zigzag loop formation now commonly employed in tungsten lamps, Daniel K. Wright, of Paterson, N. J., first winds the wire back and forth around two metal pins which are insulated from each other, and then passes sufficient current through the wire to heat the straight portions to a white heat. This is done in a vacuum or a non-oxidizing gas, and the cooling effect of the pins keeps the bends as formed, while the straight portions lose their kink. Consequently, the wire when removed will readily



No. 1,265,575.—Shaping Tungsten Filaments.

assume the desired shape. This patent was assigned to the General Electric Co.

**Fuse Holder (1,265,245).**—In the arrangement provided by Oscar H. Pieper and Alphonse F. Pieper, of Rochester, N. Y., the fuse is bent into a U-



No. 1,265,245.—Fuse Holder.

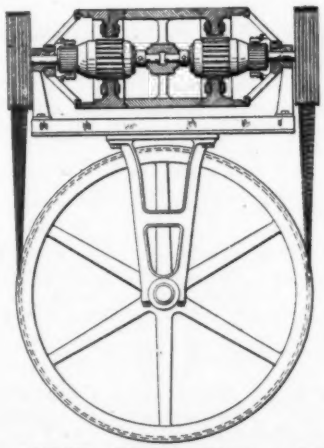
shape, and its ends are wedged between a sleeve and a pair of flexible clips.

**Electrode for Electric Furnaces (1,268,483).**—Metal is disseminated through dolomite and suitable binders, mixed with substances containing carbon, and the metal insertions are melted electrically after the mass is molded and baked, according to this patent to Hans Nathusius, of Friedenshuette, Germany.

**Special Electrode for Spot Welding** (1,267,400).—For certain types of spot welding the electrode tip is coated with a metal whose melting point is lower than that of the electrode, consequently this results in providing a thin layer of the metal between the electrode and the surface work on it. This patent, granted to James H. Gravell of Brooklyn, is assigned to the Thompson Spot Welder Company of Boston, Mass.

**Electric Flasher (1,268,652).**—An alarm clock mechanism is used as the actuating part of a small electric flasher designed by James Walton, of Phoenicia, N. Y.

**Electric Elevator System** (1,266,576).—In the traction type electric elevator system of Ethelbert M. Fra-



No. 1,266,576.—Electric Elevator Drive.

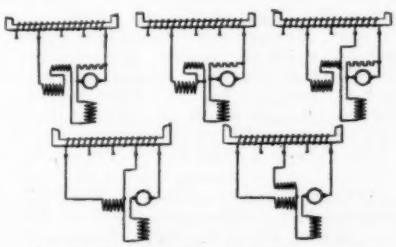
ser, two motors are mechanically connected so that a rotor of one machine rotates in the same direction as one rotor of the other machine, while the other two rotors rotate respectively in opposite directions. The patent is an improvement on that of Reissue Patent No. 13,806 and was assigned to the General Elevator Co. of Jersey City, N. J.

**Regenerative Braking System (1,268,662).**—An exciter controls the excitation of a machine which can operate alternately as a generator and as a motor. This exciter has a field winding so arranged that it carries the sum of the currents in the armature and the field winding of the machine when the latter is operating as a generator. The patent was issued to Ernst F. W. Alexanderson, of the General Electric Co.

**Lighting Fixture (1,265,885).**—For hospital use and the like, David Crownfield, of Cambridge, Mass., equips a lighting fixture with a globe and an opaque cover which can be partially rotated on the globe to direct the light in various, but limited, directions.

**Leading-In Conductors (1,268,647).**—To improve the seal-forming property of a leading-in conductor other than platinum, William Lloyd Van Keuren, of North Bergen, N. J., coats the conductor with a baked-on layer of a borate. Or, he may first cover an alloy of iron with a sheath of copper and then coat this sheath with a borate. The patent was assigned to the General Electric Co., and applies especially to the leading-in wires of incandescent lamps, rectifier or X-ray tubes, and the like.

**Control System for Alternating-Current Motors. (1,266,593).**—In operating alternating motors of the compensated, commutator type, Rudolph E. Hellmund, of Pittsburgh, Pa., initially connects the motor to the source of current for operation as a repulsion motor with an inductive de-



No. 1,266,593.—Motor Control System.

vice in series relation with the cross-field winding of the motor. Later, he operates the motor as a doubly-fed motor with the inductive device in the same relation to the cross-field winding, and finally he inserts the inductive device in the intermediate tap of the cross-field connection. He thus accelerates by the successive connections shown in the five figures of our illustration above. The patent was assigned to the Westinghouse Electric & Mfg. Co.

**Semi-Automatic Telephone System (1,268,106).**—In the system patented by Adolph Frank, of Grunewald, Germany, a preliminary connection between a calling station and the called station is established by selectors, and this is replaced by a talking connection made by switches which are partly arranged for automatic selection and partly for selection by numerical impulses.

# Latest Approved Fittings

*The electrical fittings listed and described in this department have been approved by the Underwriters' Laboratories, Incorporated, after examination and tests conducted under standards of the National Electrical Code as recommended by the National Fire Protection Association.*

**Attachment Plugs, Fuseless.**—Harvey Hubbell, Inc., Bridgeport, Conn.
Separable attachment plugs having porcelain or composition bases or caps, 660 watts, 250 volts, catalog No. 5598.
Listed May 14, 1918.

**Cabinets and Cutout Boxes, Sheet-Metal.**—Columbian Steel Tank Company, 1605-17 West 12th street, Kansas City, Mo.
Listed June 13, 1918.

**Cabinets and Cutout Boxes, Sheet-Metal.**—Nametco Products Co., Inc., 401 East 23rd street, New York, N. Y.
Listed April 11, 1918.

**Circuit-Breakers.**—The Palmer Electric & Manufacturing Company, 60 K street, Boston, Mass.
Consisting of double-pole automatic circuit-breaker, mounted in an enclosing case with reverse-phase relay. Designed for installation in polyphase alternating-current circuits to prevent operation of polyphase motors under reverse or single-phase conditions. 100 amperes, 125, 250, 440 and 550 volts. Type T.
Listed April 30, 1918.

**Conduit Boxes.**—Appleton Electric Company, 212-214 North Jefferson street, Chicago, Ill.
"Unilets." Cast-iron or pressed-steel for use at outlet and junction boxes. Service ell, hot galvanized, catalog No. 9008, with cover 6000F, catalog No. 9028, with cover 6020F.
Note: These boxes, if not entirely exposed, must be securely fastened in place independently of support afforded by conduit. In all cases covers and attachments must be exposed and easily removable.
Listed June 6, 1918.

**Current Taps.** — Hessco Electric Manufacturing Company, 120 Adelaide street, Toronto, Ont., Canada.
"Hemco Tu-Lite." 660 watts, 250 volts.
Listed May 22, 1918.

**Current Taps.**—Harvey Hubbell, Inc., Bridgeport, Conn.
"Hubbell." Multiple type, keyless, 660 watts, 250 volts, catalog No. 6553.
Listed May 13, 1918.

**Fixture, Vaporproof.** — Appleton Electric Company, 212 North Jefferson street, Chicago, Ill.
Marine type G, catalog No. 4901.
Listed May 31, 1918.

**Insulating Materials.**—The Continental Fibre Company, Newark, Del.
"Bakelite-Dilecto" X and XX grades. Insulating material, sheets, tubes and rods, having the following properties: High dielectric and mechanical strength; slightly absorptive; readily worked with tools; not strictly non-combustible.
This material is judged to be suitable for use as supports for current-carrying parts when properly enclosed or protected and where the use of a strictly non-combustible material is not practicable. This material is also judged to be suitable as a substitute for hard fiber.
Listed May 23, 1918.

**Outlet Bushings, Service-Entrance.**—Appleton Electric Company, 212 North Jefferson street, Chicago, Ill.
Porcelain fittings having separate openings for each wire, secured over end of rigid steel conduit with threaded connection. For use only at exposed end of conduit (but not under fixture canopies). Type FA, FB, FC.
Service-entrance fittings, type FEB.
Listed June 7, 1918.

**Receptacles for Attachment Plugs, and Plugs.**—Harvey Hubbell, Inc., Bridgeport, Conn.
"Hubbell," 660 watts, 250 volts, catalog No. 6179.
Listed March 21, 1918.

**Receptacles, Medium-Base.**—V. V. Fittings Company, 1910 North 6th street, Philadelphia, Pa.
"V. V." porcelain shell.
Keyless, catalog No.513P.
Listed May 16, 1918.

**Switches, Knife.**—Albert & J. M. Anderson Manufacturing Company, 289-293 A street, Boston, Mass.
"Anderson," all capacities, 250 volts, type A.
Listed April 15, 1918.

**Switches, Knife.**—The Connecticut Electric Manufacturing Company, Bridgeport, Conn.
"C. E. M. Co." 30 amperes, 125 volts, catalog No. 001.
Listed May 13, 1918.

**Switches, Knife.**—Gordon Electric & Manufacturing Company, Waterville, Conn.
30 amperes, 125 volts, catalog No. 700.
Listed May 17, 1918.

**Switches, Oil-Break.**—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.
"Westinghouse" oil-immersed, butt-contact switches, with or without no-voltage and overload release coils or both. Type 816, 550 volts or less, 30 horsepower or less.
When automatic types are used for motor control, other circuit-breakers or fuses are necessary in motor circuits if overload release devices are inoperative during process of starting motors.
This company is also prepared to furnish for circuits of higher voltages oil switches and circuit-breakers which it guarantees to be suitable for use at assigned ratings of current and voltage. Inspection departments having jurisdiction should in all cases be consulted before such switches or breakers are installed.
Listed April 17, 1918.

**Switches, Pendent.**—Benjamin Electric Manufacturing Company of Canada, Ltd., 11-17 Charlotte street, Toronto, Ont.
"Feed-Thru," catalog No. 7050.
Listed March 29, 1918.

**Switches, Pendent.** — The Bryant Electric Company, Bridgeport, Conn.
"Bryant" or "Perkins." Single-pole. Push. Catalog Nos. 2573-M, 2573-N, 2574-M, 2574-N.
Series-multiple, heater regulating. Push. 5 amperes, 125 volts, 2 amperes, 250 volts, catalog No. 2678.
Listed May 27, 1918.

**Switches, Surface.**—The Hart & Hegeman Manufacturing Company, 342 Capitol avenue, Hartford, Conn.
Heater switches—series, multiple and series-multiple. Single-pole, 2 amperes, 250 volts, 5 amperes, 125 volts, catalog Nos. 3696 and 3703.
Listed April 18, 1918.

**Tubing Fasteners, Flexible.**—Frankel Light Company, 5016 Woodland avenue, Cleveland, Ohio.
"Ohio." For securing 7/32-inch flexible tubing in outlets.
Listed June 22, 1918.

**Wire—Flexible Cord.**—National India Rubber Company, Bristol, R. I.
Marking: Two blue threads cabled with copper strands, or one red and one yellow thread cabled with copper strands.
Listed May 29, 1918.

**Wire—Flexible Cord.** — National Metal Molding Company, Pittsburgh.
Marking: One black and one yellow thread in braid, or one black and one yellow thread parallel with conductor between rubber insulation and braid.
Listed May 27, 1918.

**Wire, Rubber-Covered.** — National India Rubber Company, Bristol, R. I.
Marking: Two blue threads parallel with wire between insulation and braid, or one red and one yellow thread parallel in braid.
Listed May 29, 1918.

**Wire, Rubber-Covered Fixture.**—National India Rubber Co., Bristol, R. I.
Marking: Two blue threads parallel with wire between insulation and braid, or one red and one yellow thread parallel in braid.
Listed May 29, 1918.

# Men in Service

## Terrell Croft Joins Educational Committee of War Department—E. J. Fowler Commissioned Major—Honor Rolls

GLENN C. KILEY, of the rate department of H. M. Byllesby & Company, Chicago, has joined the National Army and will be located for the present at Camp Grant.

ERNEST G. TRUMBO, formerly electrical engineer for the Snow Storm Consolidated Mines, Troy, Mont., has been appointed master engineer of Company B, 56th Engineers, American Expeditionary Forces.

DAN M. BAGLEY of the engineering department of H. M. Byllesby & Company, Chicago, has enlisted for service in the Quartermasters' Department of the United States Army. He will be stationed for the present at Jefferson Barracks.

JOHN B. ALLINGTON, of the industrial sales department of the Rochester Railway & Light Company, Rochester, N. Y., has enlisted in the Coast Artillery Corps of the Army. He has received an appointment to the training school for non-commissioned staff officers of the Coast Artillery at Fort Monroe, Va.

H. A. HORNOR, a well known consulting engineer in the marine electrical field, was recently appointed as head of the Electric Welding Section of the Educational and Training Department of the U. S. Shipping Board, Emergency Fleet Corporation. He is now located at 140 North Broad street, Philadelphia, Pa.

LOUIS D. RUBIN, president and manager of the Louis D. Rubin Electrical Company, Charleston, S. C., has enlisted in the United States Marine Corps for duties in the signal and searchlight section. He is now engaged in active service at the Philadelphia headquarters of the signal battalion. Mr. Rubin is not severing his connection with the company and retains an interest in the business. He will also remain its president.

E. A. WEST, formerly connected with the Portland Railway, Light & Power Company and later chief engineer of the Denver Tramway Company at Denver, Colo., is now representing the division of passenger transportation of the Emergency Fleet Corporation. Mr. West is engaged in making a survey of conditions at the Portland ship yards in an endeavor to work out a solution with railroad and street car operators of the traffic problems of the Northwest.

E. J. FOWLER, formerly statistician for the Commonwealth Edison Company, Chicago, but for the past three months engaged in statistical work for the Quartermaster's Department of the army, has been commissioned a major. He is now Chief of Information and Statistics Branch in the office of the Quartermaster General of the United States Army. He is now the second ranking officer of the Edison company now in the service, Colonel Junkersfeld being the only other Edison man to hold a higher commission.

### ROLL OF HONOR.

*The electrical industry, perhaps to a greater extent than any other industry, has answered the call of the Nation for Men. As this is a war of engineers, naturally the technically trained men in the electrical industry have been in great demand and they have responded with splendid patriotism. Many of the large utility and industrial corporations have assigned men for Government service aside from those who have voluntarily entered or been called for service.*

THE ELECTRICAL REVIEW *will welcome news concerning men who have entered the service or who are engaged in any patriotic duties.*

TERRELL CROFT, University City, Mo., technical author, instructor and consulting engineer, has been called to Washington by the Educational Committee of the War Department, of which C. R. Dooley is director, and placed in charge of the work of standardizing the electrical courses of training for enlisted men, and has been granted leave of absence to accept the call of the War Department by the Luminous Unit Company of St. Louis, with whom he has recently been associated as chief engineer.

The courses are now being conducted in various schools and universities throughout the country, and the work of standardizing them is for the purpose of rendering the instruction as effective as possible by adapting it to specific war needs and eliminating all features that are considered superfluous. This will also necessitate the sectionalizing of courses for the various vocations, and it is the most important step the War Department has undertaken in educational matters, as it involves a complete reorganization of methods of instruction in more than one hundred schools and universities.

In a majority of the courses being taught, Mr. Croft's books on electricity are now being used as text books. His works on electricity and electrical engineering are held in high regard. He has had a wide experience in the various branches of electricity from lineman to consulting engineer, having worked in the former occupation before entering Pratt University, Brooklyn, from which he graduated in 1903. After graduating he became connected with the American Telephone Journal as assistant editor and while in that position conceived the idea of actually working out and recording electrical experiences. With that object in view he entered the service of the New York & New Jersey Telephone Company as apprentice and worked his way up to chief draftsman. Later he was given charge of the electrical engineering division of the American Brass Company, Waterbury, Conn. In 1910 he became connected with the Westinghouse Electric & Manufacturing Company, and was assigned the work of gathering data and writing special articles for the technical and general press. In this capacity he was transferred to St. Louis, and in 1914 he resigned to engage in practice as a consulting engineer, and also for the purpose of completing his technical works for which he had gathered data. Since that time he has taught electrical engineering at Washington University, the David Rankin School of Mechanical Trades, and the Jovian League electrical classes.

COMMONWEALTH EDISON COMPANY, Chicago, is preparing a new edition of its roll of honor, which contains over a thousand names and includes all employees who left for military service up to about July 1. Every department of the Edison company is represented in the honor roll. Twenty-seven of these men are commissioned officers, ranking from a second lieutenant to a colonel. Four of them are naval officers, three ensigns and one first lieutenant.

WILLIAM W. WELCH, formerly connected with the Mountain States Telephone & Telegraph Company at Denver, was recently commissioned a second lieutenant in the aviation branch of the Signal Corps. Lieutenant Welch was graduated from the University of Colorado, and soon after entered the employ of the Mountain States company, remaining until his enlistment in the Signal Corps. He received his first instruction in ground work at Austin, Tex., and was later sent to Dallas, Tex., where he gained experience in flying. He is now stationed at Park Field, near Memphis, Tenn., and has become qualified for pursuit work.

H. M. BYLLESBY & COMPANY and affiliated companies report that up to July 1 670 officers and employees of the organization were engaged in the military service of the United States or Allies. This number represents 13.8 per cent of all male employees of the Byllesby interests. There are now four gold stars in the flag, the following men having given their lives for the cause: D. G. Michie, formerly with the Puget Sound Gas Company, Everett, Wash., killed in action; Gillan Kane, lieutenant in the Aviation Corps, died at training camp, formerly connected with the Western States Gas & Electric Company at Eureka, Cal.; A. H. Romwaldi, lieutenant in the Italian Army, killed in action, formerly with the Western States Gas & Electric Company at Stockton, Cal., and George G. Watts, a private in Company K, 162nd Infantry, 41st Division, American Expeditionary Forces in France, died of pneumonia. He was formerly with the Oregon Power Company at Corvallis, Ore.

# Personal

## I. L. Oppenheimer Elected President Ohio Electric Light Association — G. O. House Promoted — Other Changes

HARRY V. CROLL, formerly general sales manager for Traylor Engineering & Manufacturing Company, Allentown, Pa., has gone to Los Angeles, where he becomes Southwest district manager for the same company. His district covers the entire Southwest.

MALCOLM G. CHASE, of Providence, R. I., has been appointed Fuel Administrator for Rhode Island, succeeding George H. Holmes, who resigned. Mr. Chase is a partner in the firm of Chase & Harriman, of Boston, Mass., which had developed the hydroelectric systems now combined in the New England Power Company.

G. O. HOUSE, former superintendent of the St. Paul water department, has been appointed manager of the St. Paul division of the Northern States Power Company, succeeding the late P. T. Glidden. Mr. House has recently been St. Paul superintendent of the St. Paul City Railway Company and will be succeeded in this position by J. J. Caufield, of Minneapolis. He organized the Northern Heating & Electric Company in St. Paul 14 years ago. This later became the Consumers' Power Company and later the Northern States Power Company.

ARTHUR H. YOUNG, director of the American Museum of Safety since January 1, 1917, has resigned to take charge of the Employee Relations Department of the International Harvester Company and will take up his new duties immediately. Although giving up the actual direction of the Museum's work, Mr. Young will continue to be closely concerned with its affairs, for he has been elected to the vice-presidency, succeeding the late Dr. Frederic R. Hutton. In recognition of Mr. Young's accomplishments as chief safety expert of the Federal Government, the Museum has just awarded him the Louis Livingston Seaman metal.

Mr. Young's successor is R. M. Little, formerly a trustee of the Museum and a man thoroughly versed in work along sociological lines, having served as chairman of the executive committee of the Organized Charities of Chicago and as general secretary of the Philadelphia Society for Organizing Charity. In March, 1917, President Wilson appointed him chairman of the United States Employees Compensation Commission, an office he held until called up to take active directorship of the Museum of Safety. Chester C. Rausch, who has been appointed assistant director has had a wide experience in engineering, safety and industrial work. At the time he was called to the Museum of Safety he was acting as chief safety engineer of the Navy Department, Bureau of Yards & Docks, and was stationed at Washington, D. C. Mr. Rausch is a graduate of the Boston Mechanics Art School and the Massachusetts Institute of Technology.

GEORGE J. ROBERTS, formely first vice-president of the Public Service Corporation, Newark, N. J., has been appointed head of the new Ordnance District Department for the district of New York.

I. L. OPPENHEIMER, who was elected president of the Ohio Electric Light Association at the recent annual convention at Cedar Point, Ohio, is president and general manager of the Ohio River Electric Railway & Power Company, of Pomeroy, Ohio. In 1899 Mr. Oppenheimer organized and promoted the Ohio River Company, serving the points of Hobson, Middleport, Pomeroy, Hinnersville, Syracuse and Racine. Later he acquired the Pomeroy & Middleport Power Company, of which he is also president and general manager. For a period of four years, from 1909

I. L. Oppenheimer.

to 1913, Mr. Oppenheimer was located in Lexington, Ky., while the lighting properties and railways of that city were being reconstructed, acting as general manager in charge of the street railways in Lexington, Frankfort, Paris, Georgetown and Winchester; the interurban railways radiating out of Lexington to Paris, Georgetown, Nicholasville, Versailles and Frankfort, a distance of 90 miles, and the lighting system and City Ice Company in Lexington. While in charge of those properties, he still continued control and management of the Pomeroy lighting and interurban properties.

MARTIN H. CLAPP, formerly telegraph superintendent of the Northern Pacific Railroad and president of the Association of Railroad Telegraph Superintendents, was recently appointed manager of the telegraph section, division of operation of the United States Railroad Administration and will have supervision over telegraph and telephone lines belonging to railroads under federal control. Mr. Clapp is located in the Southern Railway building, Washington, D. C.

W. H. AGENS, formerly with the Union Iron Works, Spokane, Wash., has been appointed Northwest sales manager for the Traylor Engineering & Manufacturing Company.

H. A. JOSLIN, manager of the Eugene office of the Oregon Power Company, has been appointed manager of the Dallas office of the company succeeding R. U. Steelquist.

C. E. FAHRNEY, manager of the Ottumwa Railway & Light Company, Ottumwa, Iowa, has been elected president of the Iowa Street and Interurban Association, for the ensuing year.

C. T. MAYNARD has resigned his position as electrical engineer of the Vermont Marble Company, Proctor, Vt., to become electrical engineer of the Rumford Falls Power Company, Rumford, Maine.

J. B. MOORHEAD recently resigned his position as engineer for the Pacific Telephone & Telegraph Company, Sacramento, Cal., to become identified with the Yuba Farm Tractor Company at Marysville.

C. J. SCHULTZ, formerly associated with the New Jersey Power & Light Company in the Dover District, has been appointed superintendent of the Bernardsville territory of the company, succeeding John MacLean who resigned.

CHARLES R. SMITH, of the cost department of the Robbins & Myers Company, Springfield, Ohio, has left the company to take charge of the cost and timekeeping departments at the Foose Gas Engine Company.

MARTIN H. GERRY, of Helena, Mont., formerly chief engineer of the Montana Power Company, but more recently a well-known consulting engineer of that city, has been appointed fuel administrator for Montana.

C. A. HALL has been appointed manager of the electric light and power department of the Eastern Pennsylvania Railways Company, Pottsville, Pa., operated by the J. G. White Management Corporation, New York City. Mr. Hall is a member of the National Electric Light Association and the American Institute of Electrical Engineers.

### Obituary.

CHARLE ALLIS, first president of the reorganized Allis-Chalmers Manufacturing Company, Milwaukee, Wis., died of pneumonia on July 22 at the age of 65 years. At the time of his death Mr. Allis was president of the Chicago Belting Company, a trustee and member of the executive committee of the Northwestern Mutual Life Insurance Company, and was also identified with many large manufacturing concerns. He had since the beginning of the war given most of his time to the Milwaukee County Council of Defense, and his death comes as a great shock to his many friends and business associates.

# Financial News

## Many Cities Come to Relief of Electric Street Railways.

Information compiled by the American Electric Railway Association is to the effect that revenues of practically all of the electric railways of the country in the March quarter show an increase of 2.54 per cent and 11.17 per cent in operating expenses. Net earnings decreased 13.79 per cent. During the 12 months operating ratio increased from 65.68 to 71.20.

Many communities have voluntarily increased the rate of fares. Out of sixty-seven cities in the United States having a population of more than 100,000, thirteen have permitted a 6-cent fare for street car companies, three have increased fares by establishing the zone system, four have abolished reduced rate tickets, four have been asked for a 7-cent fare with additional charges for transfers, twelve have been asked for a 6-cent fare, two have been asked for permission to charge for transfers, and thirteen companies have asked for relief in other forms.

In all, fifty-seven of the sixty-seven cities have either granted higher compensation or are considering applications for increases. There have been few instances where such applications have been formally and finally denied.

The railroad administration is taking an interest in the movement and has asked that interurban fares be increased to 3 cents a mile to be on a parity with steam road rates. There is a possibility that the railroad administration will be authorized to take charge of interurban lines if necessary steps to protect their financial structure are not taken in a reasonable time.

By contrast, reports on central electric stations show that their business mounted steadily during the first period of the year and that the central stations continue to demonstrate their strong position as essential industries. The report shows a revenue for April for the entire industry of $42,793,000 and an output of 2,401,000,000 kilowatt hours.

## Public Utilities a Question of National War Efficiency.

O. B. Wilcox, vice president of Bonbright & Company, writing in the New York Tribune of June 23, said in part:

"In the meantime the public utility question is indeed an urgent one, and its prompt solution presses upon those responsible for war efficiency. It is not a local question; it is not a question of saving the investments of scattered individuals; it is not merely a question of safeguarding insurance companies and banks, whose funds are invested in public utility securities; it is not merely a question of safeguarding the general financial situation or providing stability of earnings and integrity of investments out of which war taxes and war loans can be raised. The public utility question is clearly a question of national war efficiency, which requires immediate emergency remedies in both higher rates and capital advances—efficiency which will help us win the war, which will save the lives of our soldiers and our allies' soldiers by supplying them more promptly with the tools of war; national efficiency which, impaired, means loss of untold lives and indefinite postponement of that day to which the whole anti-German world looks forward—the day of victory."

## Union Electric Light & Power Granted Rate Increase.

In a decision by the Missouri Public Service Commission it declared the electric rates of the Union Electric Light & Power Company for energy in excess of thousand kilowatts a month are unreasonably low and the company is authorized to add a flat charge to its bills to cover the increase cost of coal, labor and taxes. The commission's action will affect only big consumers. This increase will not result in increases to householders.

## Aurora-Elgin Granted Rate Increase.

The Council of Aurora has granted the Aurora, Elgin & Chicago Railroad Company the right to charge 6 cents for city street car fares. This increase is to remain in force until July 1, 1920, provided the council does not rescind its motion. The increase was granted because the company had been operating at under an increasing loss since the war started in 1914 because of the unusual conditions presented in war times.

## Rate Advances Yield $3,000,000 to Pacific Gas.

The California Railroad Commission has just granted advances in the gas and electric rates of the Facific Gas & Electric Company, which it is estimated will add approximately $3,000,000 annually to the gross earnings of the company.

In a table appended to its decision the commission makes some interesting estimates on what effect the increased electric rates will have on the earnings of this department. Fully one-half of the company's gross earnings are derived from this department. The commission's figures, which are somewhat higher than those of the company's officials, allow the electric department an increase in gross revenue of $2,053,000 for 1918.

The gas department, it is estimated, will show an increase of $1,012,000, which together with other department earnings will bring the total gross up to $23,571,202. The company for the fiscal year ending December 31, 1917, reported gross earnings of $19,813,381. According to the same table there will be a balance this year after preferred dividends of approximately $1,930,665.

## Electric Storage Battery Doing Large Business.

A comparative statement issued by the Electric Storage Battery Company for the six months ended June 30, 1918, bears evidence of the fact that net earnings for this period are larger than for the corresponding period of 1917, and that the financial position is much stronger than it was at the beginning of the fiscal year. The company now carries on its books over $10,000,000 unfilled orders, and though the plant is turning out a greater tonnage in finished products than ever before, the amount of business is of such large volume that there is virtually no reduction in what the company has ahead all the time, new contracts constantly coming in while old ones are filled.

The treasury is in a very strong position, the working capital on borrowed notes last October having been turned over profitably, and it is planned to pay off $1,000,000 of the notes in cash at maturity next October and not renew them. While there is an option on retiring the remaining $1,000,000 notes, which do not mature for another year, it is a question whether the option will be exercised. At the beginning of 1918 cash receivables were approximately $3,000,000 and current liabilities were only $1,000,000. The excess of cash assets at the present time is greater than this. Though accounts for the past half year have not been prepared, it is believed that profits were nearer $1,500,000 than $1,300,000, as it is known that they exceeded the $1,207,061, before deduction of Federal taxes, earned in the first half of 1917. After taxes, in the full year 1917, the earnings were a trifle over $2,000,000, or 12½ per cent on $16,129,925 stock.

In addition to Government contracts for batteries for submarines, submarine chasers, wireless, telephone and searchlight equipments, etc., the Electric Storage Battery Company is doing other work which is considered of national importance at this time. This latter includes batteries for trucks used at industrial plants and piers, and for mining locomotives. These devices help to conserve the man power of the country and are among the busiest lines of the company at present.

## Increased Operating Costs of Commonwealth Power.

The Commonwealth Power, Railway & Light Company has issued a special letter of explanation to stockholders which accompanies its monthly report. The company shows that gross receipts have increased 10.17 per cent in the first five months of the calendar year, while operating expenses increased 26.79 per cent. Operating expenses totaled $5,331,000 and out of this total the following five items have been segregated:

| | |
|---|---|
| Increased cost of coal for electric plants | $123,000 |
| Increased cost of coal for steam heat | 73,000 |
| Increased cost of gas, coal and oil | 433,000 |
| Increased cost of snow removal | 68,000 |
| Increased cost of car repairs | 130,000 |
| Total | $827,000 |

## Northern Texas Earnings Show Increase.

The Northern Texas Electric Company and subsidiary companies report gross earnings for April of $267,914, which compares with $175,359 for the corresponding month of 1917, an increase of $92,555. After operating expenses and taxes of $157,422, net earnings of $110,491 were accounted for. Other income totalled $9583, bringing the gross income to $120,074, against $71,352 for the same period of the preceding year. Interest charges of $25,277 and sinking fund requirements of $2959 were deducted, leaving a balance for dividends, reserves and replacements of $91,839. Gross revenue for the twelve months ended April 30 last were $2,932,283, an increase of $903,318 over the previous twelve months. Operating expenses and taxes totalled $1,646,832, compared with $1,200,271 for the same period of the year before. Other income of $67,083 was added to net earnings of $1,285,451, bringing the total income to $1,352,534. Balance amounted to $1,006,971, compared with $480,336 for the corresponding months of the previous year, an increase of $526,635.

## Cities Service Earnings Show Large Increases.

Cities Service Company for June, 1918, and for the six months and 12 months ended June 30, 1918, showed large increases over the corresponding periods of the preceding year. For the 12 months ended June 30, 1918, requirements for payment of the preferred dividends were earned 5.18 times compared to 4.91 times for the preceding 12 months, and after payment of preferred dividends there was earned for the 12 months ended June 30, 1918, $61.62 a share on the common stock, compared to $54.61 a share for the 12 months ended June 30, 1917. For the six months ended June 30, 1918, requirements for payment of the preferred dividends were earned 5.57 times and the balance after payment of preferred dividends applicable to surplus, reserves and dividends on the common stock was equivalent to $34.40 for the six months period. These figures were after adequate reserves had been made from profits of subsidiary companies for payment of all Federal income and excess profit taxes as well as all other charges.

Continued progress is reported from the utility subsidiaries. There have already been secured a number of rate increases at various utility properties, latest among these being good advances in rates for Brush Electric Company at Galveston, Tex., and Cumberland & Westernport Electric Railway Company at Frostburg, Md. A number of rate advances are pending before various local bodies and the outlook is that within a comparatively short time these will have been approved also. Rates for power are being generally advanced in order to conform them to increased cost of operation, and the outlook now is that the utility subsidiaries of Cities Service Company will report substantially better net earnings in the current year than they did in 1917.

## Dividends.

The directors of the Cities Service Company have declared the regular monthly cash dividend on preferred stock of one-half of one per cent at the rate of 6 per cent per annum, and the regular monthly cash dividend of one-half of one per cent, or 6 per cent per annum, and three-fourths of one per cent, or 9 per cent per annum in stock, on the common stock.

The board of directors of the Kings County Electric Light & Power Company has declared a regular quarterly dividend of $2.00 per share on the amount of the capital stock outstanding, payable September 3 to stockholders of record August 31.

American Waterworks & Electric Company has declared a quarterly dividend of 1¾ per cent, payable August 15 to stock of record August 10.

Pacific Power & Light Company has declared a quarterly dividend of 1¾ per cent on preferred stock, payable August 1 to stock of record July 22.

Tampa Electric Company has declared a quarterly dividend of $2.50 per share, payable August 15 to stock of record August 1.

Philadelphia Company has declared a semi-annual dividend of $1.25 on preferred stock, payable September 1 to stock of record August 5.

Commonwealth Power, Railway & Light Company has declared a quarterly dividend of 1½ per cent in scrip on preferred stock, payable August 1 to stock of record July 17.

Kellogg Switchboard & Supply Company has declared a quarterly dividend of 2 per cent, payable July 31 to stock of record July 25.

Columbia Gas & Electric Company has declared a quarterly dividend of 1 per cent on capital stock, payable August 15 to stock of record July 29.

## Earnings.

### UTAH POWER & LIGHT COMPANY.

May gross, $443,413, increase $37,568; net income, $99,988, decrease $5,154. For 12 months: Gross, $5,414,522, increase $738,052; net income, $1,258,180, increase $35,494.

### AMERICAN TELEPHONE & TELEGRAPH.

Net earnings of the American Telephone & Telegraph Company for six months ended June 30 show an increase of more than $3,000,000. The Bell Telephone System showed a loss of approximately $2,000,000. Figures for the American Telephone & Telegraph Company compare:

| | 1918. | 1917. |
|---|---|---|
| Operating revenue | $29,497,261 | $25,812,096 |
| Net earnings | 26,219,452 | 23,613,112 |
| Balance after dividends | 4,129,980 | 3,951,088 |

### WESTERN UNION TELEGRAPH.

For six months ended June 30, 1917 and 1918 (month of June, 1918, estimated):

| | 1918. | 1917. |
|---|---|---|
| Total revenues | $42,776,182 | $36,416,175 |
| Maintenance repairs and reserved for depreciation | $ 5,602,495 | $ 4,698,335 |
| Other operating expenses, including rent of leased lines and taxes | 30,378,326 | 24,225,024 |
| Total expenses | $35,980,821 | $28,923,359 |
| Balance | $ 6,795,361 | $ 7,492,816 |
| Deduct interest on bonded debt | 665,925 | 665,925 |
| Net income | $ 6,129,436 | $ 6,826,891 |

### ALABAMA POWER.

Gross earnings of the Alabama Power Company for May were $239,408, an increase of $77,206. After operating expenses and taxes and net was $150,268, an increase of $45,129.

### CITIES SERVICE COMPANY.

| | 12 months ending June 30, 1918. | 12 months ending June 30, 1917. | Month of June, 1918. | Month of June, 1917. |
|---|---|---|---|---|
| Gross earnings | $20,907,945.77 | $15,865,984.47 | $1,808,929.16 | $1,388,560.74 |
| Expenses | 398,630.73 | 300,302.68 | 38,392.84 | 29,784.79 |
| Net earnings | $20,509,315.04 | $15,565,681.79 | $1,770,536.32 | $1,358,775.95 |
| Interest on notes and debentures | 13,814.69 | 13,999.19 | 5,750.73 | 233.50 |
| Net to stock | $20,495,500.35 | $15,551,682.60 | $1,764,785.59 | $1,358,542.45 |
| Dividends preferred stock | 3,951,898.50 | 3,166,462.65 | 336,641.50 | 301,057.50 |
| Net to common stock and reserves | $16,543,601.85 | $12,385,219.95 | $1,428,144.09 | $1,057,484.95 |
| Debenture fund | | | | $ 458,522.35 |
| Contingent fund | | | | 816,388.39 |
| Stock surplus | | | | 3,516,843.50 |
| Surplus reserve | | | | 4,515,072.31 |
| Surplus | | | | 21,683,859.02 |

### BELL TELEPHONE SYSTEM.

| | Average first half 1913-1915. | Average first half 1916-1917. | First half 1918.* |
|---|---|---|---|
| Exchange revenues | $ 79,103,512 | $ 97,537,330 | $108,615,000 |
| Toll revenues | 28,767,682 | 37,276,131 | 44,991,000 |
| Miscellaneous revenues | 1,088,993 | 1,375,426 | 1,650,000 |
| Total operating revenues | $108,960,187 | $136,188,887 | $155,256,000 |
| Depreciation | $ 19,980,135 | $ 25,117,885 | $ 23,440,000 |
| Current Maintenance | 15,320,319 | 17,778,779 | 21,775,000 |
| Traffic expenses | 20,726,828 | 28,482,666 | 40,390,000 |
| Commercial expenses | 11,498,238 | 13,316,821 | 15,244,000 |
| General and miscellaneous expenses | 5,154,546 | 6,121,137 | 7,544,000 |
| Total operating expenses | $ 72,680,066 | $ 90,817,288 | $108,393,000 |
| Net operating revenues | $ 36,280,121 | $ 45,371,599 | $ 46,863,000 |
| Uncollectible revenues | $ 776,497 | $ 729,977 | $ 665,000 |
| Taxes | 5,949,916 | 7,978,445 | 10,700,000 |
| Operating income | $ 29,553,708 | $ 36,663,177 | $ 35,498,000 |
| Net non-operating revenues | 3,107,578 | 3,769,780 | 4,415,000 |
| Total gross income | $ 32,661,286 | $ 40,432,957 | $ 39,913,000 |
| Rent and miscellaneous deductions | $ 2,061,395 | $ 1,870,905 | $ 2,154,000 |
| Interest deductions | 8,972,044 | 10,020,977 | 10,858,000 |
| Total deductions | $ 11,033,439 | $ 11,891,882 | $ 13,012,000 |
| Balance net income | $ 21,627,847 | $ 28,541,075 | $ 26,901,000 |
| Deduct dividends | 15,468,664 | 17,697,502 | 19,800,000 |
| Surplus earnings | $ 6,159,183 | $ 10,843,573 | $ 7,101,000 |

### WEEKLY COMPARISONS OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeiler & Co., Rookery Bldg., Chicago.

| Public Utilities— | Div. rate. Per cent. | Bid. July 16. | Bid. July 23. |
|---|---|---|---|
| Adirondack Electric Power of Glens Falls, common | 6 | 15 | 15 |
| Adirondack Electric Power of Glens Falls, preferred | 6 | 73 | 68 |
| American Gas & Electric of New York, common | 10+extra | 80 | 80 |
| American Gas & Electric of New York, preferred | 6 | 39 | 39 |
| American Light & Traction of New York, common | .. | 193 | 184 |
| American Light & Traction of New York, preferred | 6 | 92 | 92 |
| American Power & Light of New York, common | 4 | 39 | 39½ |
| American Power & Light of New York, preferred | 6 | 66 | 66 |
| American Public Utilities of Grand Rapids, common | .. | .. | .. |
| American Public Utilities of Grand Rapids, preferred | 6 | .. | .. |
| American Telephone & Telegraph of New York | .. | 96¼ | 96 |
| American Water Works & Elec. of New York, common | .. | 4½ | 4½ |
| American Water Works & Elec. of New York, particip | 7 | 11 | 11 |
| American Water Works & Elec. of New York, first preferred | .. | 53 | 53 |
| Appalachian Power, common | .. | 3 | 3 |
| Appalachian Power, preferred | 7 | 20 | 20 |
| Cities Service of New York, common | +extra | 204½ | 204½ |
| Cities Service of New York, preferred | 6 | 74¼ | 74 |
| Commonwealth Edison of Chicago | 8 | 100¾ | 100 |
| Comm. Power, Railway & Light of Jackson, common | .. | 19 | 20 |
| Comm. Power, Railway & Light of Jackson, preferred | 6 | 40 | 45 |
| Federal Light & Traction of New York, common | .. | 7½ | 7½ |
| Federal Light & Traction of New York, preferred | .. | 35 | 35 |
| Illinois Northern Utilities of Dixon | 6 | .. | .. |
| Middle West Utilities of Chicago, common | 2+extra | 10 | 10 |
| Middle West Utilities of Chicago, preferred | 6 | .. | 37 |
| Northern States Power of Chicago, common | .. | 40 | 40 |
| Northern States Power of Chicago, preferred | ex.div.7 | 81 | 80 |
| Pacific Gas & Electric of San Francisco, common | .. | 36½ | 35¼ |
| Pacific Gas & Electric of San Francisco, preferred | 6 | 80 | 80 |
| Public Service of Northern Illinois, Chicago, common | 7 | 73 | 71½ |
| Public Service of Northern Illinois, Chicago, preferred | 6 | 82½ | 82 |
| Republic Railway & Light of Youngstown, common | 4 | 18 | 18 |
| Republic Railway & Light of Youngstown, preferred | 6 | 57 | 57 |
| Standard Gas & Electric of Chicago, common | .. | 4 | 4 |
| Standard Gas & Electric of Chicago, preferred | 6 | 21 | 20 |
| Tennessee Railway, Light & Power of Chattanooga, common | .. | 3 | 3 |
| Tennessee Railway, Light & Power of Chattanooga, preferred | 6 | 14 | 14 |
| United Light & Railways of Grand Rapids, common | 4 | 29 | 29½ |
| United Light & Railways of Grand Rapids, preferred | 6 | 61 | 61 |
| Western Power of San Francisco, common | .. | 13 | 14 |
| Western Power of San Francisco, preferred | 6 | 49 | 50 |
| Western Union Telegraph of New York | extra | 87 | 84 |
| **Industrials—** | | | |
| Electric Storage of Philadelphia, common | 4 | 53 | 50 |
| General Electric of Schenectady | 8 | 145 | 144 |
| Westinghouse Electric & Mfg. of Pittsburgh, common | 7 | 42 | 42¼ |
| Westinghouse Electric & Mfg. of Pittsburgh, preferred | 7 | 60¼ | 60 |

*Last sale.